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## THE MYSTERY OF LIFE.*

BY THE BISHOP OF LONDON.

[THE Bishop of London said that he desired to take that opportunity of setting forth some traits in the character of a religious physician—an outline, as it were, of that ideal which should ever be before the eyes of a medical student who desired to be really worthy of the noble profession to which he was devoting himself.]

Look at the study, [Bishop Temple proceeded], by which you are to prepare yourselves for the exercise of your future duty. The subject of that study is by far the most complex, the most finished, of all the works of God. Life itself is the most mysterious thing we know in the world of nature. It seems to have no analogue.

In so far as matter is subjected to any kind of either mechanical or chemical action, these may involve almost any degree of change in outer form, but the substance appears to remain the same. As a proof of this, whatever may be done in this way may be undone. What has been compounded may be resolved, what has been resolved may be re-compounded. There is no progress whatever, although there may be infinite variety of combination. There is no increase or possibility of increase of the forces at work. There seems to be no increase or possibility of increase of the material to be worked on. Science assumes, and appears to be justified in assuming, that the original quantity of matter, however it came into being and whatever forms it may have assumed, yet remains exactly what it was, that no particle of it is annihilated and no particle of it is added. Science seems equally justified in assuming that the original quantity of force, however it came into being, passing through every variety of change, sometimes showing itself in heat, sometimes in light, sometimes in electricity, and sometimes in visible motion, nevertheless remains always the same. Thus motion may be converted into heat, but whatever heat is thus produced a corresponding amount of motion must be destroyed.

From this restraint life is free. It exists, it can be communicated, it can be destroyed. But the communication of life by one living form to another by no means involves the destruction of life in that which first possessed it.

And as life stands alone in its power of indefinite increase and diminution, so does it stand alone in the mystery of its origin. The theory of spontaneous generation has been upset in every instance whenever it seemed for a moment to be established.

And while life is thus mysterious in its origin, how wonderful also is it in its development. Nothing else shows itself capable of such progressive ascent from lower forms to higher, from simple to complex, from plain to beautiful, from weak to powerful, from blind to intelligent. Nothing else has in it the same wonderful promise for the future to correspond with all that we know or can reasonably infer from its history in the past. The meanest living creature seems potentially far above the grandest mass of inanimate matter.

And if life, considered in itself, be thus marvellous, how far more marvellous in its most perfect form when, in the human framework, it is the seat and organ of the faculties of sense, of intelligence, of reason and conscience, each in succession rising above the other until we pass beyond the physical to the spiritual nature, and find ourselves contemplating a being whose constitution makes him akin to the Creator of all things, capable of understanding the laws according to which all things have been made, of appreciating the order, the beauty, the sublimity of the universe, of forecasting the aim and purpose to which all things are tending.

This is the subject of the physician's and the surgeon's study, no other can rank higher. With what manly reverence, equally removed from shallow and vulgar coarseness and from silly superstition, will the religious student regard the human body which he studies, and which he daily finds more clearly proved to be the most perfect of all God's works on earth! In his studies he is perpetually on the confines of that mysterious interval, whatever it may be, which separates mind from matter, the spiritual from the physical.

It is impossible for any lengthened investigation, especially if we are examining disease, not to find mind acting very seriously on matter in ways outside what we commonly understand by human action.

And closely akin with this is the near connection of the practice of medicine with the religious life and with the place assigned in that life to prayer. The tendency of science unquestionably is to confine the proper subject of prayer to spiritual things only. And this, not because there is the slightest reason supplied by science for doubting the power of God, but because science leads us more and more to the belief that such interference is exceedingly rare, and, therefore, that frequent interference is not in accordance with the character of God's government. *The reverent and dutiful soul will shrink from asking what there is real reason to believe that it is not His will to do.*

If we pray for our friends in illness, yet there are limits to what we can reverently pray for. We could not pray that a man who had lost an arm should have another in its place. The laws of our physical constitution may be—for purposes of science we rightly assume that they are—similar in character to all other physical laws. But the spiritual comes in so strangely and sometimes so powerfully that we never know what may be

* The opening address of the medical session, delivered by the Bishop of London to the students of King's College Hospital.

the precise working of our drugs, our dieting, our nursing. There is always room for the unseen and unknown and unsearchable. There is no check on the freedom of earnest prayer, however scientific may be the process which the healing art shall prescribe.

The religious student, over and above his sense of the dignity of his subject, will have further the sense that in a very marked degree he approaches to the spiritual world, and to Him who made and rules it. He will realise that he is dealing with what is not physical only, and this will give to all his researches a thoughtful, reverent, self-controlled character which will show itself even in his manner.

The very purpose of the profession is to alleviate human suffering. Sympathy with suffering is the characteristic and the essence of the profession. The physician and the surgeon ought to be—how very often they are—the tenderest, the most merciful, the most sympathising of men.

It is, no doubt, often necessary in the practice of medicine to inflict pain in order to save life, or in order to prevent still greater pain which is seen to be approaching. It may, perhaps, be necessary, in the investigation of medical science, to inflict severe pain on the lower animals while searching into the nature of their bodily powers in order to compare them with our own. But in every case the true physician or surgeon, remembering the supreme purpose for which he lives, will insist on retaining his own tenderness of feeling, will inflict no severe pain that he can by any possibility avoid, will make what pain he inflicts as brief (if it may be so, as instantaneous) as he can possibly make it, will never repeat pain for the mere purpose of the greater certainty of his conclusions, will refuse altogether to inflict pain even for the highest scientific ends if the degree of it be so excessive as to make him feel that nothing would ever induce him to submit to it himself or make him think it just that a stronger being than he should inflict it on him. Nothing can justify him in ceasing to be a man in order to become a more effective scientific instrument of research, nor can the religious investigator surrender that sympathy with all suffering which is his highest title to the respect of himself and fellows.

## THOUGHT AND LANGUAGE.

By Ada S. Ballin.

XVIII.

IN a former article, treating of the origin of the various signs current among different nations, as expressions of negation and affirmation,* I showed how natural signs had, by abbreviation, become conventional. I have again alluded to it for the purpose of pointing out that the same process which influences the gesture language, is one of the chief causes of change in verbal language at large. All words are more or less traceable to a sensuous origin. Even words apparently so purely symbolic as the pronouns are found to be mutilated forms of conceptual words. Thus the relative pronoun in Chinese was once a substantive meaning *place;* and the Hebrew *asher*, which signifies *as*, *that*, or *which*, is related to *athar* in Aramaic, which means a *place;* in Assyrian, *asru*. The Assyrian *mala*, *as many as*, is really a substantive meaning *fulness*, connected with the Hebrew *maleh*, *full*. The Ethiopic *lālī* and *cīyā*, which, combined with suffixes, express the nominative and accusative of the personal pronoun, formerly signified *separation* and *entrails*. The Malay *ulun*, *I*, in Lampong still means *a man;* and in Kawi *I* and *a man* are represented by the same word *ngwang*. In Japanese the same word may serve for all three persons, and was originally a substantive meaning *servant*, *worshipper*, or something similar. In Chinese for *I* it is only polite to say *ts'il;* the *thief*, and *mine* and *thine* are respectively *tsiân*, *bad*, and *ling*, *noble*. In Greek, ὅδε ὁ ἀνήρ, *this man here*, is an equivalent for *I*.

Words from constant use get worn down, like coins, and their original meanings become effaced; they dwindle into mere enclitics—"empty words," as the Chinese call them, and are attached as prefixes or suffixes to other words, the meaning of which they serve to modify. Thus the Hebrew *bêt*, *house*, abbreviated, becomes the prefix *b*, meaning *in*. It is thus that what the ancients called secondary words were derived from the primary.

Although the processes of phonetic decay were not dreamed of until quite modern times, the principle was clearly understood many centuries ago. This is evident from the "Dialogue Cratylus," in which Plato shows a true grasp of the nature of language and mastery of the subject as far as the knowledge of one language—Greek—could enable the philosopher to infer anything about language in general. In this marvellous work three distinct theories of language, which were probably current in the various schools of the time, are set forth. These may be called—1, the Divine; 2, the conventional; and 3, the natural. Thus Cratylus is represented as believing that a superhuman power gave things their first names, which are, therefore, necessarily their true names. On the other hand, Hermogenes maintains that names are given purely by convention and the habits of the users, and in support of this argument instances the fact that in different cities and countries different names are used for the same things. While Socrates holds that language is natural and also conventional, a position in which he is strengthened by all the facts of modern linguistic science.

Just as natural signs by abbreviation and other changes, brought about by carelessness in their performance, may become conventional; so by phonetic change may the origin of words be obscured, and what may be called *natural* words become conventional.

In his interesting commentary on this "Dialogue," Jowett remarks:—"In a sense, Cratylus is right in saying that things have by nature names, for nature is not opposed either to art or law. But vocal imitation, like any other copy, may be imperfectly executed, and in this way an element of chance or convention enters in. There is much which is accidental or exceptional in language. Some words have their original meaning so obscured that they require to be helped out by convention. But, still, the true name is that which has a natural meaning. Thus nature, art, chance, all combine in the formation of language; and the three views respectively propounded by Hermogenes, Socrates, and Cratylus, may be described as the conventional, the artificial or rational, and the natural. And this view of Socrates is the meeting-point of the other two, just as conceptualism is the meeting-point of nominalism and realism."*

The great stumbling-block in the way of the progress of the science of language, as it has been in so many other sciences, is the endeavour to simplify in theory to an extent not warranted by the facts at hand. Thus various schools of philologists have maintained different theories

* No. X.

* "Dialogues of Plato," Vol. I., p. 622-3.

of the origin of language, each accounting for it by one cause and ignoring all other influences. We have had the Onomatopœtic, or imitative theory; the Interjectional, which maintains that language is derived from the imitation of interjections; and, finally, Max Müller's theory that, as everything in Nature produces certain sounds or rings, language has its origin in this. The first two theories have been nicknamed by Max Müller the Bow-wow and Pooh-pooh theories; while, in revenge, Prof. Whitney has called the last the Ding-dong theory. These nicknames perhaps show better than anything else the utter contempt in which each party holds the hypotheses of the others, yet each has a certain amount of right on his side, and all might be reconciled to each other, and from the materials of their own form a theory which would be in accordance with all the facts in our possession if they would only be convinced that, into a great and complicated matter like that under discussion, a variety of elements must necessarily enter. This truth was evidently partially grasped by Plato, and it has been clearly brought out by Jowett, both in the preceding passage and in the succeeding, which I quote as a model of liberal thought and clear exposition of a difficult point. He continues:—

"Neither is Plato wrong in supposing that an element of design and art enters into language. The creative power abating is supplemented by a mechanical process. 'Languages are not made, but grow'—but they are made as well as grow; bursting into life like a plant or flower, they are also capable of being trained, and improved, and engrafted upon one another. The change in them is effected in earlier ages by musical and euphonic improvements; in later ages by the influence of grammar and logic, and by the poetical and literary use of words. They develop rapidly in childhood, and when they are full grown and set, they may still put forth intellectual powers, like the mind in the body; or, rather, we may say, that the nobler use of language only begins when the framework is complete. The savage or primitive man in whom the instinct is the strongest is also the greatest improver of the forms of language. He is the poet or maker of words, as in later ages the dialectician is the definer or distinguisher of them. The latter calls the second world of abstract terms into existence, as the former has created the picture sounds which represent natural objects or processes. Poetry and philosophy—these two are the two great formative principles of language when they have passed their first stage, of which, as of the first invention of the arts in general, we only entertain conjecture. And mythology is a link between them connecting the visible and the invisible, until at length the sensuous exterior falls away, and the severance of the inner and outer world of the idea and the object of sense becomes complete. At a later period logic and grammar, sister arts, preserve and enlarge the decaying instinct of language by rule and method, which they gather from analysis and observation." *

## THE ECLIPSED MOON SUNLIT.

By Richard A. Proctor.

FROM letters which have reached me I find that the illumination of the moon during central lunar eclipse is not understood by many, who yet have read the usual explanation as given by Sir John Herschel and by others. What I did a little time ago in the way of supplementing that explanation was found by some to have the effect of making clear to them how imperfect had been their previous knowledge of the matter, and how incorrect had been many of their notions respecting it. I had already recognised that this must be so. For those mistakes and misapprehensions which I had proposed to correct (those, that is to say, which I had noticed in Mr. Mattieu Williams's "Science Notes" in the *Gentleman's Magazine*) showed clearly that the general reader must be apt to misunderstand the usual explanation altogether. I had also noticed mistakes by others who might have been expected not only to follow understandingly the correct (but incomplete) explanation given by Sir John Herschel, but to be capable of interpreting the matter for themselves.

I propose now to consider, not those circumstances which I dealt with before, but the preliminary explanation, which I assumed before to have been to some degree mastered and understood. I deem it a duty to do this, and to do it in these closing numbers of the weekly Knowledge, because many seem to imagine that the matter is in some degree in dispute; whereas the only difficulty there really is in the matter is to make that clear which everyone acquainted with the laws of geometrical and physical optics knows to be true.

Mr. Williams, indeed, considers that he has been entirely misunderstood by me, a supposition natural enough in such cases, where there will generally be misapprehension even on the part of those who have mastered a subject—misapprehension as to the exact way in which the facts have been misunderstood. One is apt to suppose that *this* particular mistake is likely, and *that* mistake impossible, when, as it turns out, it has been the seemingly impossible mistake, not the likely one, which has really been made. For this reason I will not follow the rather confused reasonings by which the mistaken views I set out to correct have been supported. I will not endeavour to ascertain from them precisely how those mistaken views arose. In the advocacy of mistaken views there is necessarily confusion often worse confounded than the original mistake).

I take then the mistaken notion that during total lunar eclipse the moon is lit up only or chiefly by light from our illuminated atmosphere, the ruddy twilight glow in our air,—not by rays which have come from the sun himself, in the same way precisely that rays come to us from the setting sun. That this mistake was originally made by Mr. Williams is obvious in two ways: First it was essential to the theory in hand that this misapprehension should be entertained, and secondly the mistake was directly involved in the deduced estimate of the amount of sunlight falling on the moon during totality. Remove this mistake, and the theory of a self-luminous moon is at once shown to be superfluous,—and (through its superfluity) as impossible as water standing an inch above a goblet's brim.

The mistake evidently had its origin in the idea that when the earth lies between the sun and moon, the atmosphere of the earth plays the part of the outer shell of a spherical lens, bringing the solar rays to foci between the earth and the moon. The idea manifestly was—and and I find the idea is quite commonly entertained—that the moon, being set where she is, at the time of central eclipse, receives rays corresponding only to that particular position of these imagined foci which brings them at or near her surface. The fact that rays from every part of the sun reach the moon if she is beyond her mean distance, and from nearly every part when she is in perigee (rays

* Vol. I., p. 645.

from every part of the sun reach *nearly* the whole of the moon's surface even then), that in point of fact the sun would be absolutely visible, though distorted, from every part of the moon's surface at the time of central total lunar eclipse, is regarded as incredible. Yet it is the simple truth.

This is precisely the fact which I not only took for granted, but which I treated—in my former papers—as a fact which should be obvious to every one likely to be studying this subject at all. The only difficulty I could see—in fact the only difficulty there is, but it is much more troublesome than I imagined — is a difficulty which would quite as much trouble an unsound reasoner in trying to determine whether the sun would be visible through the effects of refraction after he had really set in the geometrical sense. If we did not actually see the sun in this way, I imagine we should find many persons capable of clearly proving that the sun could not be so seen, or only by a very small portion of his light. One of these—misapprehending perhaps an explanation by Sir John Herschel—might reason thus:—

Fig. 1.

Suppose H E to be the plane of the horizon, and put H A to represent the air at H (it is a little wild to represent the air by a straight line, but Herschel, who unfortunately seems to have had little skill in planning diagrams, represents the earth herself by a straight line in the corresponding part of his explanation of the ruddy eclipsed moon) E, the eye of an observer. Then if a ray S A from the sun S below the horizon is refracted in the direction A E, it will reach the observer at E, but only just that ray; for a ray S $a$ will be refracted to $e$ far on one side of him, and a ray S $a'$ will be refracted to $e'$ far on the other side of him. Therefore he will get but the merest fraction of the sun's light, and to say that he will actually see the sun, (apart from atmospheric absorption) as well as if the sun were above the horizon is absurd on the face of it. And so forth.

Only, as a matter of fact we see the sun, and so this false reasoning never gets fairly started,—as the corresponding false reasoning about the ruddy eclipsed moon very naturally has been.

Now let us consider the real facts in regard to the moon.

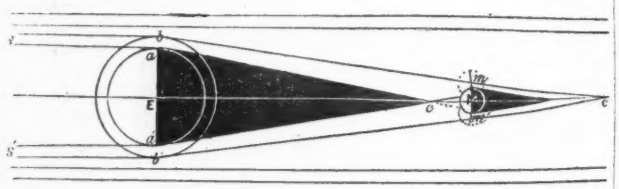


Fig. 2.

Let the lines in Fig. 2 be supposed to represent rays coming from a point on the sun, very far away on the left to the earth E and the moon M at the time of total eclipse. The rays which come through the atmosphere at $a$ and $a'$, just touching the earth are bent through an angle of about 34′ as they enter and as much as they pass out, so that they are deflected through an angle of about 68′ in all and cross at a point as $c$ which lies on the line E M, not far from the moon M, because the angle $a$ M E (or more precisely because the angle whose *sine* is E $a$ ÷ E M) is only about 58′, whereas the angle $a\,c$ E is about 68′. Rays which pass higher up, as at $b$ and $b'$ are deflected less, and cross as at $c'$, on E M produced, farther and farther away till we get no deflection at all and the rays simply radiate on straight lines diverging from the particular point on the sun we are considering. If $b$, $b'$, are at a height of 3½ miles where the atmospheric density is reduced one half, the deflection will be about one half what it is at the sea-level, or the angle $b\,c'$ E about 34°, so that rays travelling so high in our air would pass considerably beyond the moon when she is situated as shown in Fig. 2, supposed to correspond to the time when the particular point on the sun considered is just centrally beyond the earth supposed to be seen from the moon.

So far we have what Sir John Herschel has pointed out, in the passage whose full meaning has been so strangely misunderstood. The moon at M gets but a small proportion of the rays carried around the earth in the way shown. In fact as we know that she subtends about 32′ as seen from the earth, she only gets those rays, of the particular set illustrated above which are deflected within 16′ on either side of 58′,—that is, which are deflected between 42′ and 68′ (none are deflected between 68′ and 74′, the necessary angle to just reach the lower edge of the moon from near $a$ and the higher edge from near $a'$.)

If we suppose rays from the middle of the sun's disc (as seen from the earth or moon) dealt with in Fig. 2, it is easy to make the same figure by a slight addition illustrate the case for rays from points on the edge of that disc. For a line from the edge to E (that is, from either point on the edge of the solar disc in the plane of our figure) would be inclined either in direction E $m$ or E $m'$, where the angle $m$ E $m$ (bisected by E M) is the angle subtended by the sun's disc. We shall be near enough to the truth in putting $m$ and $m'$ on the outline of the moon at M. Then, instead of encumbering our figure and our minds by drawing a complete set of rays for each or for either of these directions, all we need do is to regard the set of rays already drawn as corresponding to either case, and setting a moon at $m$ and at $m'$ as shown. For either of these moons, the case is illustrated in which the particular point on the sun's surface dealt with lies at the edge of the sun's disc as seen from the earth or moon.

Now in reality this—so far as a general explanation of the illumination of the moon's surface during totality is concerned—ought to be enough. Sir John Herschel was content to give even less in the way of explanation and illustration. Yet he showed clearly enough all that is really essential.

But strangely enough this explanation has been altogether misapprehended. It has been supposed to show that the moon can receive scarcely any light from the sun by the actual deflection of solar rays towards her, insomuch that the light thus received counts for little or nothing compared with such illumination as the moon receives from our terrestrial twilight glow, from the burnishing of the edge of our earth's disc by solar illumination. That from the moon's surface situate as in Fig. 2, the sun himself is actually visible, so distorted and so reduced in apparent size that much less light than usual comes from him, but still that it is his very own self which is seen, as certainly as the setting sun is seen by

us after geometrical sunset is completed,* this, which is really shown by the above explanation, remains with many a matter not only hard to see, but actually to be denied as absurd on the face of things.

The difficulty commonly presents itself in this way. If by the bending power of the earth's air rays from a particular part of the sun's disc are deflected to the moon, then rays from another part of the sun's disc must be deflected away from the moon; how then can all parts of the sun's disc be visible from the moon? Added to which comes another difficulty, based on a different misapprehension,—If light from every part of the sun reached the moon she would not be in eclipse at all, but shine as brightly as ever.

Let us see how the matter really is:—

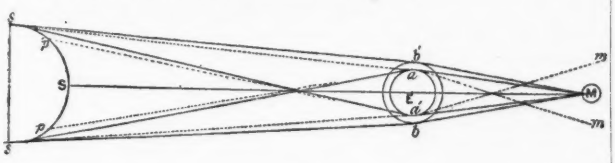


Fig. 3.

Suppose first that $s\,a$ is a ray from the lowest point $s$ of the sun S (lowest considered with reference to the figure) to the earth's atmosphere at $a$ and so deflected as to pass to the moon at M. Then it is obvious that a ray $s'a$ from the highest point $s'$, will be carried as to $m$, and not reach the moon at all. *But* a ray from $s'$ to some point $b'$ in the atmosphere above $a$, will be deflected precisely to M. Thus an eye placed at M would see the part $s'$ of the sun in the direction M $b'$, and the part $s$ in the direction M $a$, and all intermediate points on the face $s$ S $s'$ in directions intermediate to M $a$ and M $b$. Thus the diameter of the sun's disc from $s$ to $s'$ (the semicircle $s$ S $s'$ in reality would be transformed into a short straight line $a\,b'$ on the edge of the earth's disc as seen from M. In like manner the same diameter of the sun's disc would also be transformed into a short straight line $a'b$ on the opposite edge of the earth's disc, by rays following courses ranging from $s'\,a'$ M to $s\,b$ M. Imagining the plane of the figure to revolve on the straight line S E M, we get the same result for every diameter of the sun's disc,—or the sun transformed into a ring around the earth, in the manner already dealt with (all but these preliminary and I had supposed nearly obvious considerations).

Here we have supposed the moon in apogee. If she is nearer the earth the point $s$ on the sun will not be rendered visible by refraction at $a$, which would carry it above the moon. A ray from some point $p$, near to $s$ would be so carried, and the arc $p$ S $s'$ would be visible at $a$ transformed into a straight line as $a\,b'$, while a corresponding arc $p'$ S $s$ would be visible at $a'$ transformed into a straight line as $a'\,b$. The whole sun would be visible, but not *every* part of the sun *doubly* visible as in the former case.

These rays thus falling on the moon are rays of actual sunlight, not different from the rays by which we see the setting sun except in having some of them traversed a greater range of terrestrial atmosphere, and so having suffered more absorption, and making the ring into which the sun is transformed or distorted look, at least along its inner edge, much ruddier than our setting sun usually looks. I say "some of them," because clearly the rays which like $s'\,b'\,M$ have only traversed the higher regions of our air would not suffer absorption in anything like the same degree.

And here, in passing, let me remark that Mr. Ranyard's idea that the parts of our air above the highest range of clouds may be (or as he suggested *must* be) the parts chiefly acting in carrying sunlight to the moon during total eclipse, is inadmissible. The refractive power of air is nearly proportional to its density. At a height of $3\frac{1}{4}$ miles the air will not deflect the sun's rays more than 34′, as already mentioned, and in central total eclipse this would not suffice to bring a ray of sunlight to the moon. For, as supposed to be geometrically measured from the moon (one cannot say "seen" because it would be hidden), the edge of the sun's disc at the time of central eclipse would be more than 40′ from the edge of the earth's disc. Probably the highest part of the air effective at that time in bringing the sun into view would be not more than two and a half miles above the sea-level, and it could not be more than three miles. Clouds float much higher than that. If further proof were needed, it would be found in the ruddy colour of the eclipsed moon, which shows that usually the light she then receives has traversed the lower strata of our air.

This in reality is a sufficient solution of the problem of the ruddy-eclipsed moon. At least the solution is sufficient when combined with such an inquiry into the amount of illumination which the moon would receive, as I gave in former papers. What else I then wrote was chiefly an elaboration of the necessary part of the explanation, by an investigation of the actual nature of the distortions of detail which the sun's face would undergo.

(*To be concluded in our next.*)

* Geometrical sunset is completed when the sun's globe has passed below the plane of the natural horizon.

## OPTICAL RECREATIONS.

By a Fellow of the Royal Astronomical Society.

(*Continued from p.* 270.)

So far we have only spoken of light and darkness as the results of polarisation. It remains briefly to touch upon the gorgeous chromatic phenomena exhibited when light thus altered in its character traverses certain minerals and organic substances. We will, first of all, say something of the phenomena themselves, and then endeavour to afford, very shortly indeed, as much of an explanation of their cause as can be given without the employment of mathematics. The mineral known as Selenite will supply us with material for the experiments we are about to make. It is the crystalline form of gypsum (from which Plaster of Paris is made by burning it). Crystals of it are very common in the London clay of the Isle of Sheppey, whence we ourselves have obtained numerous specimens. Very well, then: obtaining one of these crystals we shall find that it is of a slab-like form, and is made up of innumerable thin plates, which may be split off with a sharp penknife. Let us remove as thin a slice as we can of this. Now, suppose that the rhombs in Fig. 47, the tourmaline plates in Fig. 48, or the mirrors in Fig. 49 (see *ante*, p. 197), are so placed that the image of the original source of light is extinguished, let us place our film of selenite between the polarizer and the analyser (in Fig. 49 A, it would be put through the slit S, square to the axis of the tin cylinder), and upon now looking through the second rhomb or slice of tourmaline, or

into our little mirror, C, we shall see the field lighted with the most lovely colours. We have said colours, because the chances are considerably against the beginner splitting off a film of identical thickness in all its parts from the selenite. Should he succeed in obtaining one of the same thickness throughout, then will the colouring of the field of view be homogeneous. In the first case, he will get patches of the most vivid and gorgeous yellow, blue, red, and green, &c.,—in the latter one of such colours alone. Now let us turn our analyser slowly round through 45°, and we shall find the colours, or colour, gradually fade until the light will pass through the film seemingly unaltered. Proceeding now to rotate the analyser through another 45°, the colours will begin to reappear, *but they will be complementary to the original ones;* that is to say, if the plate transmitted green light in the first position of the analyser, it will now let red light through. If it appeared blue originally, it will now seem yellow, and so on; the colours thus exhibited always being those which, mixed together, form ordinary white light. As the rotation is continued, the changes described will recur (of course, in reversed order) until the analyser has been turned 360° round the ray of light as an axis. Mica, if sufficiently thin, will exhibit similar phenomena, as will thin slices of quill or horn, tartaric acid crystallised on a plate of glass, the frost ferns on the window-panes in winter, and numerous other substances. Let us, in conclusion, see whether we cannot obtain some general idea of the manner in which these most striking and beautiful appearances are produced.

If we remove the analyser, and look at the beam of light proceeding from the polarizer through our film of selenite or other material alone, we shall see such light absolutely uncoloured. Hence it is obvious that the analysis of this whole light, or its separation into colours, is effected by the analyser. Now, selenite is a doubly refracting crystal, and when the polarised ray enters it, it is resolved into two rays, vibrating at right angles to each other. These rays are differently bent; and bending in a refracting medium means going more slowly, the ray which is the more bent being the tardier of the two. From this it will be readily seen that one of these rays may get half a wave-length, or any odd number of half-wave lengths, ahead of the other (Vol. VII., p. 321), and that, as formerly explained (*loc. cit.*), they may *interfere*. A little further consideration, though, will show that while these rays are composed of vibrations occurring at right angles to each other, it is physically impossible that interference can occur. But the analyser twists the two planes of vibration into coincidence, so that the waves can now destroy each other. Selenite, or any other doubly-refracting material, has, of course, a sensible thickness, and we have seen formerly (Vol. VII., p. 541) that waves of red light are much longer than those of blue. Consequently we shall require a thicker plate of selenite to retard the red rays sufficiently to extinguish them than we shall if we want to blot out the blue rays. Hence, when these longer waves have been neutralised by interference, the plate of selenite will shine with the colours produced by the shorter ones. *Vice-versâ*, when the shorter waves have been annihilated, the longer waves will get through the analyser, and the colour of the field be derived from the less refrangible end of the spectrum.

Into the exquisite phenomena of circular and elliptical polarisation, it is impossible to enter here. An account of these must be sought in works specially devoted to the subject. All we have essayed to do is to introduce the student to the practice of some remarkable experiments which may be performed at little or no cost; and which serve to admit us to a nearer view of the intimate nature of Light.

## OUR HOUSEHOLD INSECTS.

By E. A. Butler.

### HYMENOPTERA.

(*Continued from page* 264).

THE ants referred to in our last paper are genuine household insects, spending the whole of their lives in the shelter of our abodes, breeding amongst us, and bringing up their extensive families year after year in the same spot, as long as provisions are plentiful in the immediate neighbourhood. But this is not the case with the wasps, the next section of the Hymenoptera which will engage our attention. It is true that occasionally their nests are found in outhouses or lofts, or under the eaves of thatched roofs; but this is exceptional, and, as a rule, they enter our houses only in their adult condition; still, they are then such tiresome pests—at least, in imagination, if not always in reality—that we cannot forbear to grant them a place amongst our household insects.

Notwithstanding the popular prejudice against wasps, there are many points of interest in connection with them. Their economy is remarkable, and inferior in interest only to that of bees and ants; their courage is certainly extraordinary; and though they are frequently an annoyance to us through their intrusive habits, yet there are, as we shall presently see, some counterbalancing advantages following from their mode of life; and, finally, their character is not really quite so black as it has been painted. That they are not, as some people seem to suppose, actuated by an irreconcilable hostility to human kind has been sufficiently demonstrated by observers who, like Sir John Lubbock, have closely studied their habits, and have found it possible to tame them and make pets of them, and to induce even such fiery-tempered beings calmly to feed out of their hands and to crawl over their persons without bringing their murderous weapons into requisition. Indeed, one observer, Dr. Ormerod, expressed his opinion that they are much less fickle and more reliable than bees—an opinion, however, which will probably not be generally endorsed.

They will rarely attack unless provoked, and, though it is not easy to maintain a philosophic composure and indifference when a wasp is buzzing round one's head, yet such would no doubt be the best policy; at any rate, the violent flourishes and dashes so often made against them with handkerchiefs, knives, or what not are more likely to irritate than to drive away insects so renowned for valour. Of course, when we attack their citadel, they will at once assume the offensive (as who would not?), and fight to the death for house and home. Very hot or windy weather, too, seems to bring out whatever spitefulness they possess, but this also is a psychological experience not altogether foreign even to *Homo sapiens* himself!

In distinguishing wasps from other Hymenoptera no reliance must be placed on the mere presence of yellow bands on the body, for though all wasps, of whatever habits, have these, such a style of ornamentation is by no means confined to them, but is of frequent occurrence throughout the whole order. But there is a certain peculiarity of the wings that will at once separate a wasp

from the crowds of other yellow-banded insects. All wasps have four wings, and this will serve to distinguish them from certain two-winged flies of the order Diptera, with which they are sometimes confounded, but will not distinguish them from other Hymenoptera, as four is the natural number of wings in this group. But the anterior wings are folded longitudinally in repose, *i.e.*, when a wasp closes its wings it not merely lays them along its back, as a bee would do, but also folds each fore-wing along a line running from its attachment to the thorax to the middle of the outermost or rounded edge of the wing (Fig. 1), the lower and more flexible part being bent

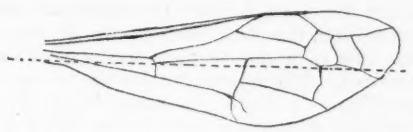

Fig. 1.—Wing of Wasp, showing line of folding.

under the rest, so that the wing becomes only half as broad as before.

In consequence of this peculiarity, the name Diploptera, or "doubled-wings," is given to that section of the order which contains all the wasps, and by this peculiarity they may at once be distinguished from all other Hymenoptera. One would naturally suppose that there must be some connection between this curious habit and the economy of the insects—something to account for so strange a departure from the general practice of the order; but if there be, it has yet to be discovered.

Our British wasps are of two totally distinct kinds. Those that usually obtrude themselves upon our notice are the *social* wasps, of the family *Vespidæ*, and, like the ants and other social insects, they exhibit the peculiarities of the three so-called sexes, the common abode, and the common labour for the common welfare. But besides these there are the *solitary* wasps, of the family *Eumenidæ*, which, from their habits of burrowing in sandy banks, are often called Sand Wasps and Mason Wasps. These have but two sexes, do not form large communities, and, after having provisioned their nest with food sufficient to last the whole lifetime of the larvæ, leave their young to take care of themselves. They are less robust than the *Vespidæ*, and though still yellow-banded, have a much larger proportion of black about their bodies.

It is only very occasionally that we find solitary wasps in our houses; their young feed upon small caterpillars and other insects, and the chief business of the parents' life is to provide a stock of these, so that they have not the temptation to intrude on our privacy which the *Vespidæ* have, for the latter are almost omnivorous, and there are plenty of things in our houses which suit their taste admirably. The solitary wasps of the genus *Odynerus* do, however, sometimes construct their small nests in the most outlandish places. The nests consist of separate cells, each closed in and complete in itself, and devoted to the use of a single grub. Each contains an egg and a store of little caterpillars, each stung by the mother wasp sufficiently to prevent it from being at all lively, but not sufficiently to cause it to die and shrivel up.

These little clusters of cells have been found, amongst other strange places, inside the lock of a kitchen-door, where, notwithstanding the noise and disturbance caused by the passing and repassing of persons continually going in and out of the kitchen, the mother built cells for her brood, provisioned them, and sealed them up, and the young went through all their metamorphoses successfully, appearing in the kitchen when they had assumed the perfect form, to the no small surprise of its inmates.

In the keyhole of an eight-day clock-case, too, one family was brought up, appearing to be in no way disturbed by the ticking or periodical winding-up of the clock. They have also been found in the drawer of an old-fashioned looking-glass, in the folds of a piece of paper that had fallen behind some books, in hollow reeds used as thatch, and in the barrels of a pistol that was hanging invitingly on a post. In all these cases, accident furnished the insects with cavities ready made, and saved them the trouble of excavating their own burrows. These wasps are also sometimes seen in windows, buzzing about, apparently endeavouring to discover why a medium so transparent as glass should yet be able so successfully to bar their exit into the outer world.

The abdomen of an *Odynerus* is of a very curious shape. In all the wasps, the first segment seems more or less like a cap on the succeeding ones, but this is much more markedly the case in the solitary than in the social species. In the genus *Odynerus* the abdomen bears a ludicrous resemblance to a peg-top surmounted by a polo cap which is rather too small for it (Fig. 2). The second segment is of enormous size compared with the succeeding ones, and being very convex above, forms the head of the top. This segment is black, except the hind border, which is yellow, and the succeeding segments are more or less deeply margined with the same colour. The basal segment, *i.e.*, the cap, is also furnished with a yellow marginal band, the shape of which is an important aid in the identification of the species. The folded wings and the top-shaped abdomen are quite sufficient to enable any one to recognise a sand-wasp.

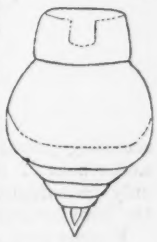

Fig. 2.—Abdomen of Odynerus.

The *Vespidæ*, or social wasps, which are much more frequently seen in our houses, we must reserve for the next paper.

*(To be continued.)*

## THE YOUNG ELECTRICIAN.

By W. Slingo.

*(Continued from p. 249).*

Ex. CIX.—Before leaving the question of electroscopes there are one or two points that it will not do to overlook. Nothing was said in the previous article about a base for the instrument described, nor is it essential to have one, as it can be simply stood on the table, or any other dry substance. However, there is

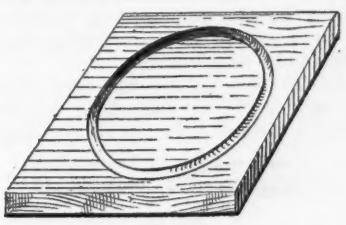

Fig. 64.

some danger of damaging the leaves when carrying the instrument from place to place if there is nothing to exclude currents of air. Fig. 64 gives a general idea of a

base that will prove as useful as any. It consists simply of a piece of board, say three-quarters of an inch thick and one to two inches larger than the instrument. The board may be square or round, and in it cut, or have cut by some friend in possession of a lathe, a circular groove a quarter of an inch deep and about the same width. The groove should be of such a diameter that the glass may stand in it without touching either side of it. Having placed the glass in position, pour into the groove some liquefied paraffin wax until the level of the board is reached. This is simply to lightly cement the wood and glass together to permit of the instrument being carried about, and to exclude moisture, &c. Feet may be provided by

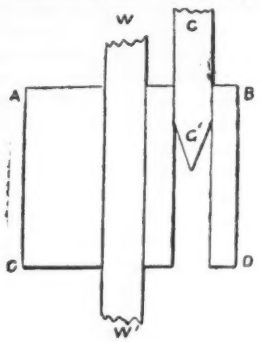


Fig. 65.

screwing pieces of wood of equal thickness on to the under side of the piece of board. The thickness need only be sufficient to allow the fingers to pass underneath the base for lifting purposes.

For my own part I rarely use a base, but, before commencing to work my electroscope, lay it carefully on its side before the fire, to dry the glass and expel as much of the moist air as possible. Something of the kind should be done before fixing the glass on to the base, or the instrument is likely to prove of little use on account of the confined moisture.

Ex. CX.—Another plan, which I have frequently and satisfactorily resorted to, is to provide the stopper (D, Fig. 61) with two holes, as shown in section in Fig. 65, where A B C D is the stopper and W W′ the brass rod or wire. The second hole is bored parallel to it and of such a width, say a quarter of an inch, as to allow a piece of glass tubing, G G′, to fit tightly. The tubing, it will be seen, is sealed at one end. The object is to enable one to drive out the damp air by gently warming the instrument when in the ordinary vertical position, the piece of tubing being withdrawn to permit the escape. When the warming is finished the tubing may be restored, and a further supply of moist air, which would otherwise find its way in, excluded. Where the cemented base is used the piece of tubing may be also cemented in (after the drying operation) by means of shellac varnish, &c., as it will rarely require to be withdrawn.

Ex. CXI.—To seal up the end of a piece of glass-tubing is a matter of little difficulty. All that is necessary is to hold a piece of ordinary glass-tubing over a gas

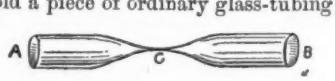


Fig. 66.

or spirit flame, placing one hand at A (Fig. 66) and the other at B, and revolving the glass gently in the flame, which we will suppose to be at or under C. When the flame turns decidedly yellow in colour, the glass may be regarded as having been more or less softened. It should then be withdrawn from the flame and pulled apart with both hands. The diamater of the tube will in consequence be diminished, and may be made as small as we wish. As we at present only require a short, taper point, the pulling should be done as quickly as possible. If it were required to produce a long taper or a very fine hair-like tube, the pulling should be gradual, but equably maintained. A great deal depends upon the shape of the flame employed. When a short taper is required, only a narrow flame, such as that from a small spirit-lamp, should be used. But for most purposes, such as bending, long tapers, &c., a good batswing gas flame answers as well as anything, the glass being placed in the plane of the flame, that is, so that the greatest possible length of glass is heated. The reasons for this are too apparent to need detailing. It should be borne in mind that the glass should be thoroughly dried before being placed in the flame, as the smallest drop of water falling on the heated part is sufficient to fracture it. The glass should also be *kept revolving* during the whole of the time it is over the flame, or it will be unequably heated, and will, therefore, only extend badly, possibly it will break.

### Condensing Electroscopes.

Ex. CXII. Fig. 67 illustrates a useful addition which may be applied to our electroscope. It is known as a "condensing" plate, and consists primarily of a piece of sheet metal provided with an insulating handle, and having its under face coated more or less perfectly with an insulating material. The plate A B may be of tinned

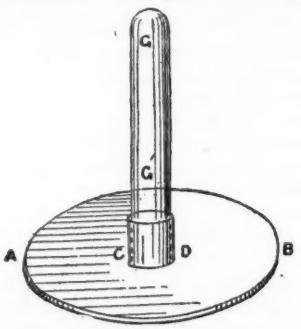


Fig. 67.

iron or any other metal, but brass looks best and costs but very little. It should be of the same size as the plate or cover of the electroscope (A, Fig. 61), and may be of the same thickness. In the centre of it a small piece of half-inch brass tubing C D should be soldered (Ex. XI. to XIV). The length of the tubing need not be more than half an inch. Then procure a piece of glass tubing, G G′, five or six inches long, and about three-eighths of an inch in diameter; the end G of the glass should be sealed by revolving it in a good strong flame, holding it in a slightly inclined position, so that the glass will have a tendency to run down. If need be, the sealing may be assisted by using a piece of glass in the other hand and working the end G therewith. When the sealing operation is completed the end G′ of the tubing should be placed in the soldered cup C D and cemented in with a little plaster of Paris. When the latter is dry the handle G G′ should be coated with a layer of shellac varnish, whereby a good insulating handle is insured. If the sealing cannot be accomplished by

fusing the glass, the tube may be plugged with a small piece of dry wood or with a little plaster of Paris, and then well coated with shellac; or, instead of either of these, a stout test-tube may be employed, inverting it and cementing the open end. It only remains now to coat the under surface of A B with shellac varnish and the apparatus is complete. With it many interesting and instructive experiments can be performed.

Ex. CXIII. A more elaborate, but in some cases more useful form of condensing electroscope is illustrated in Fig. 68, where C D E F is a wooden base about three-quarters of an inch thick, six inches wide, and fifteen or eighteen inches long. L is our electroscope (Fig. 61), W W', the wire bent so that the plate A becomes vertical instead of horizontal. B is the condensing plate illustrated in Fig. 67, a piece of quarter inch glass *rod* being used instead of the piece of tubing G G. The rod is bent similarly to W, and the lower end fastened by plaster of Paris into a foot made by soldering a piece of brass tubing on to a piece of brass, K, which slides over the two strips of brass H H and L L, screwed along the middle of the base, the strips being half an inch wide and long enough to reach from within an inch or so of the electroscope to the opposite end F D of the base; they need not be more than a sixteenth of an inch thick; they should be a quarter of an inch apart; but before being

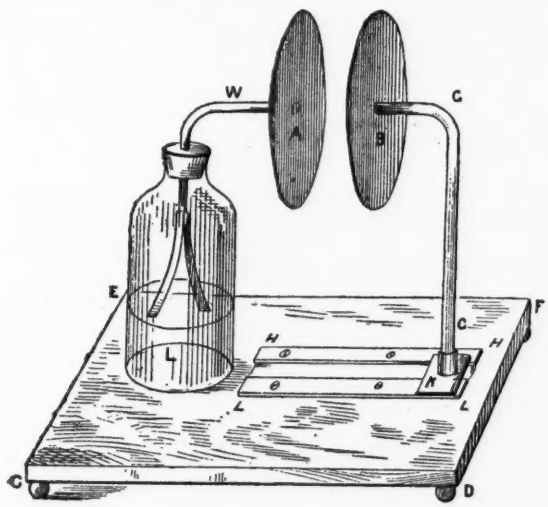


Fig. 68.

fixed, the wood separating them should be cut out with a chisel and saw, a slot being thereby made a quarter of an inch wide and equal in length to the brass strips. Similar strips should also be screwed on to the corresponding portion of the under side of the base. The foot-piece, K, has to support B and the glass rod, and must also offer facilities for changing the distance between the plate A and B. To do this satisfactorily, K should present a vertical section, as shown in Fig. 69. This may be easily made. Cut two pieces of sheet brass, an eighth of an inch thick and measuring three-quarters of an inch wide by an inch long. These form the upper and lower pieces, A B and D C, which slide over H H, L L, and the corresponding underneath pieces respectively. C is a piece of brass a quarter of an inchthick, an inch long, and seven-eighths of an inch wide, the width being just a trifle in excess of the distance between the upper surfaces of the strips H H L L, and the lower surfaces of the strips beneath. A B and D E, being screwed or soldered on to C, a very efficient foot, K, is at once provided and the movable plate, B, can be easily placed at any distance from A, within the range of the instrument. The foot might also be made from a solid piece of brass, filing out the necessary portions. When it is desired to connect B to earth, the back surface may be touched with the finger, or a piece of loose chain (Ex. VIII.) may be passed round the piece of brass tubing into which the upper end of G is cemented. It would be as well to coat G G with shellac varnish.

Ex. CXIV. A makeshift which I have occasionally resorted to with advantage when hard up for an electroscope, and when the necessary materials are not to hand,

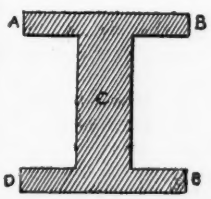


Fig. 69.

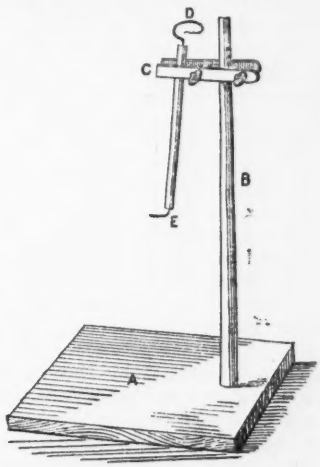


Fig. 70.

is illustrated in Fig. 70. An ordinary wooden retort stand is used, or (as is here shown) a wooden base A is provided with a wooden rod B; two pieces of wood are screwed together on opposite sides of the rod, so as to clamp it securely, and at the same time to hold in position at C a piece of well-insulated (gutta-percha covered) wire D E bared at the extremities, the upper end D being bent in to a loop so as to prevent the extremity acting as a point and discharging any electricity produced in the instrument. The lower end E is bent at right angles, the extreme point being turned back, and a gold or Dutch-metal leaf hung over the wire so that the two pendant parts are of equal length. Any open-mouthed jar, such as the receiver of an air-pump, a pickle-bottle, &c., placed on the base and the leaves suspended within it completes the apparatus, which for temporary purposes will do all that can be fairly expected of it.

There are very many interesting and instructive experiments which may be performed with the electroscope: some of them I have already dealt with; those pertaining to the condensing form of the apparatus should, in a measure, suggest themselves. In the main, they turn on the question of induction, and it is to be hoped that with the apparatus so far constructed, the Young Electrician will pass many a pleasant hour during the fast-approaching winter.

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The destruction of Flood Rock, near Hell Gate, the preparations for which were detailed in a recent issue of Knowledge, was to have been effected yesterday, but, owing, it is said, to slight imperfections in the insulation of wires, used to complete the electrical firing circuit, the explosion has been postponed until Saturday.

## MYSTERIES AND MORALITIES.

By Edward Clodd.

### CONCLUSION.

THE introduction of Moralities dates from the reign of Henry VI., that is, about the middle of the fifteenth century. The personification of abstract qualities which had already found its way into the Mysteries* was a necessary element as the religious plays became less historical and more didactic in character, and the popularity of Moralities obviously quickened, because they were admirable vehicles for attacks upon or defence of current beliefs and superstitions, and could readily concern themselves with the social, political, and religious questions of the time, expressing through their allegorical character the thoughts of men's minds upon these topics.

The earliest extant English Moralities are in manuscript, and of these Mr. Payne Collier gives interesting abstracts in his "History of Dramatic Poetry."† whilst Mr. Carew Hazlitt, in the additions which he has made to the re-issue of Dodsley's "Old Plays," has supplied us with several valuable specimens. The moral play with which that edition opens is not so early as was once held, but is especially interesting, as setting forth the advantage of the pursuit of natural knowledge. It is entitled, "A New Interlude and a Mery of the Nature of the Four Elements (*i.e.*, the earth, the water, the air, and fire), and is assigned to the early part of the sixteenth century. The "Messenger," a name usually given to the prologue, is followed by Natura Naturata, who discourses, it must be admitted very tediously, to Humanity, upon the ethereal region of the heavens and the lower region of the earth, and counsels him to study these. Humanity is, however, beguiled by Sensual Appetite, but, at the last, accepts Nature's reproof. The only known copy of the play is imperfect, the middle and concluding leaves being lost.

Of a still earlier date, although printed in 1522, is the "Propre Newe Interlude of the Worlde and the Chylde," in which the several stages of human life are represented, Man appearing successively as Infans, Wanton, Lust and Lykynge, Manhode and Age. Perseverance recites to him the "Twelve Articles of the Faith" and "The Commandments Ten," when Age signifies his adhesion, and is thereupon named Repentance. ‡

In the more important "Morall-playe of Everyman," we meet with some admirable moral teaching in association with expositions of the Roman Catholic religion, the defence of which appears to have been one of the objects of the play. Everyman is the representative of the human race, and is summoned by Death, already personified in the Coventry plays as the messenger of God, to appear before the Divine tribunal, and bring his "book of counte," for

> "a reckoning he will need have
> Without any lenger respite."

In his fear, Everyman asks his friends—Fellowship, Kindred, Goods, Strength, Beauty, and others—to accompany him; but they one by one forsake him when they learn who has summoned him; and in his despair he betakes himself to Good Deeds, "who is so weak that she cannot stand, verily." She upbraids him for neglect, but leads him to her sister Knowledge, who takes him to the holy man Confession. Everyman then does penance, receives the sacrament, and, with comforting words from Good Deeds, expires. Whereupon the Doctor who has attended him steps forward and delivers the moral:—

> Ye herers, take it a worthe olde and yonge
> And forsake Pryde, for he deceyves you in the ende,
> And remembre Beaute, v. wyttes, Strength, and Discrecion,
> They all at last do Everyman forsake,
> Save his Good Dedes; there do he take;
> But beware, for, and they be small,
> Before God he hathe no helpe at all.*

An Act was passed in the reign of Henry VIII., forbidding any person to "play in interludes, sing or rhyme any matter contrary to the doctrine of the Church of Rome." This was repealed under Edward VI., and accordingly among the Moral Plays of his time we have, in "Lusty Juventus," a defence of the Bible against tradition and the superstitions of the Romish Church. The "parsonages that speake" are "Messenger, Lusty Juventus, Good Counsaill, Knowledge, Sathan the devyll, his son Hypocrisie, Felowship, Abhominable Lyvying, and God's Mercifull Promises." Lusty Juventus represents the "frailtie of youth," of "nature prone to vyce," and is led astray by a gay woman, Abhominable Lyvyng, but finally reclaimed by good Counsaill. The edifying speeches of Good Counsaill and Knowledge are fortified with Bible references by no means contributory to the rhythm, as thus:—

> The prophet David saith, that the man is blessed
> Which doth exercise himsel in the law of the Lord,
> And doth not follow the way of the wicked;
> As the first psalm doth plainly record;
> The fourscore and thirteenth psalm thereunto doth accord.
>
> My meaning is, as Christ saith in the sixth chapter of Matthew,
> To do to him as you would be done to.
> I will show you what Saint Paul doth declare
> In his Epistle to the Hebrews and the tenth chapter.†

Satan is wittily represented as lamenting the downfall of the old religion: "ful well," he says,

> I know the cause,
> That my estimacion doth thus decay;
> The olde people would beleve stil in my lawes,
> But the yonger sort leade them a contrary way.
> They wyll not beleve, they playnly say,
> In old traditions and made by men,
> But they wyll lyve as the Scripture teacheth them.

Hypocrisie recites a long list of the mummeries by which he had deceived men "since the world began":

> Holy cardinals, holy popes,
> Holy vestments, holy copes,
> Holy pardons, holy beads,
> Holy saints, holy images,
> With holy, holy blood.
> Holy stocks, holy stones,
> Holy clouts, holy bones,
> Holy wax, holy lead,
> Holy water, holy bread,
> Holy brooches, holy rings,
> Holy kneeling, holy censings,
> And a hundred trim-trams mo.‡

But such contempt was not confined to the Protestants. In John Heywood's "Enterlude of the Four P's," *i.e.*, a Palmer, a Pardoner, a 'Poticary, and a Pedlar, the author, although a staunch Catholic, flings some coarse satire against the relic-mongers. The play itself is amusing as hinging on a dispute between the four characters as to who could tell the biggest lie. The credit falls to the Palmer, who remarks incidentally that he never saw a woman out of patience, whereupon the others, taken off their guard, declare it to be the greatest lie they ever heard. It is through the Pardoner that Heywood directs

* Vide Knowledge, p. 219, Sept. 11, 1885.
† Vol. II., pp. 200—216.
‡ Dodsley, vol. i., p. 273.

* Collier, II., 228.
† Dodsley, Vol. I., pp, 55, 59.
‡ Dodsley, Vol. II., pp. 65-6.

his attack on the religious frauds of the mendicant friars. He represents him as exhibiting wine drunk at the wedding of Adam and Eve; "a box full of humble bees that stung Eve as she sat on her knees tasting the fruit to her forbidden;" a slipper of one of the Seven Sleepers; the jaw-bone of All Saints; a buttock-bone of the Holy Ghost; and "the great toe of the Trinity," on which the 'Poticary remarks:—

> I pray you turn that relic about:
> Either the Trinity had the gout,
> Or else, because it is three toes in one,
> God made it as much as three toes alone.*

Mr. Herbert Spencer, in his *Study of Sociology*, refers to an illuminated missal in the possession of Mr. Huth, in which the Trinity is represented by three persons standing in one pair of boots. Heywood's satire is justified by the disclosures made in his time in the report of the Commissioners appointed by Thomas Cromwell to inquire into the state of the monasteries,† and by the currency of legends such as that gravely related of St. Clara de Monte Falconis:—

> That after her death there was found in her gall a plain testimony of the Holy Trinity, consisting of three balls of equal figure, colour, and size, and of equal weight, one weighing the weight of two and also of three, yet all three weighing no more than one!

But we pass beyond the assigned limits of our subject in referring to the Interludes, so called because they were played in the intervals of banquets and other festivities, since these fill the gap between the Moral-play and the regular drama. The abstract characters of the former were slowly displaced by concrete figures from history, the portrayal of whose actions came so much nearer men's "business and bosoms" in those stirring times than any life of prophet, warrior, or king of a remote past and unsubstantial age, however crowded with supernatural detail. In addition to this, the institution fell into disrepute by reason of the indecency and buffoonery which were no longer in harmony with the improving taste of the people. So the religious drama passed from the hands of the guilds to those of the strolling player in town and country fairs, and the bans of the heralds to the "walk up, walk up" of the puppet showman. In the *Spectator* of March 16, 1711, Steele intimates that Powell the showman exhibited religious subjects with his puppets under the little piazza in Covent Garden, and talks of "his next opera of *Susannah* or Innocence betrayed, which will be exhibited next week with a pair of new *Elders*," while the following droll specimen from Strutt's *Sports and Pastimes* also evidences to the performance of Mysteries in this country as late as the eighteenth century:—

> "*By her Majestie's permission.* At Heatly's booth, over against the Cross Daggers, next to Mr. Miller's booth, during the time of Bartholomew Fair, will be presented a little opera, called *The old creation of the world*, newly revived, with the addition of the glorious battle obtained over the French and Spaniards by his Grace the Duke of Marlborough. The contents are these:—
>
> 1. The creation of Adam and Eve.
> 2. The intrigues of Lucifer in the Garden of Eden.
> 3. Adam and Eve driven out of Paradise.
> 4. Cain going to plough, Abel driving sheep.
> 5. Cain killeth his brother Abel.
> 6. Abraham offering his son Isaac.
> 7. Three wise men of the East guided by a star, who worship him.
> 8. Joseph and Mary flew away by night upon an ass.
> 9. King Herod's cruelty; his men's spears laden with children.
> 10. Rich Dives invites his friends, and orders his porter to keep the beggars from his gate.
> 11. Poor Lazarus comes a begging at rich Dives' gate, and the dogs lick his sores.
> 12. The good angel and death contend for Lazarus's life.
> 13. Rich Dives is taken sick and dieth. He is buried in great solemnity.
> 14. Rich Dives in hell, and Lazarus in Abraham's bosom, seen in a most glorious object, all in machines descending in a throne, guarded with multitudes of angels, with the breaking of the clouds, discovering the palace of the sun, in double and treble prospects, to the admiration of all spectators. Likewise several rich and large figures, with dances, jiggs, sarabrands, anticks, and country dances between every act: compleated with the merry humours of Sir John Spendall and Punchanello, with several other things never yet exposed. Perform'd by Mat Heatly. Vivat Regina."*

Enough, however, has been said and cited to show that the Miracle Play has an interest not so much for the antiquarian as for the student of culture. Our knowledge of the manifold causes which contributed to the moral development of England during the thirteenth, fourteenth, and fifteenth centuries would be very imperfect if we omitted the influence of this institution on a people among whom only portions of the Bible began to be circulated as late as the sixteenth century. It at least powerfully affected human conduct in supplying men with conceptions, rude and false though we now know them to have been, of a divine government of the world and a tribunal at which they would at the last be judged, but at the same time it did quite otherwise than contribute to the permanence of any one form of theology. In view of the political and personal causes which in England precipitated the Reformation, it is not easy to apportion to the religious plays of that period their share in the dethronement of sacerdotalism, and in the substitution of the authority of the Bible for that of the Church, which proved to be but an exchange of fetters; enough that they were on the liberal side, even when it seemed otherwise. For as the permanent in thought cannot be literalised and localised, the representation of the Deity in a linen coat and gloves could only quicken the advance of conceptions which refuse to surround Him with the limitations of Personality.

* "Dodsley," Vol. I., p. 362.

† Langton sends to Cromwell, among other reliques, Our Ladies smock, parte of God's supper, a fragment of stone from the manger at Bethlehem, while Dr. London sends from the abbey of Reading "the principal relique of idolytrie within this realm—an angel with one wing that brought to Caversham the spearhede that percyd our Saviour his syde upon the Crosse." In the inventory of reliques in the abbot's house, we find "two peces of the Holye Cross, Saynt James his hand, a bone of Mary Magdalene, a chow-bone of Saint Ethelwolde." Vid. *Suppression of the Monasteries.* Camden Society, 1843, pp. 58, 227.

## LIVE STOCK IN EUROPE.†

THE United States Consul in Copenhagen, writing on the subject of the live stock in Europe, says that the number of horned cattle throughout Europe is estimated at about 92,000,000, of horses 36,000,000, of sheep 200,000,000, and of swine about 46,000,000. Of the European States, the Scandinavian countries and Servia stand in a prominently favourable position as regards the relative amount of their live stock to the inhabitants, Denmark ranking first on the list with 755 head of horned cattle per 1,000 inhabitants, next Servia with 609, then Norway with 562, and, lastly, Sweden with 483. France may be taken as representing the European average, whilst below the average come Great Britain, Spain, Belgium, Greece, Portugal, and Italy. Of sheep, Servia has relatively the largest number, namely, 2,200 head for 1,000 inhabitants, and Greece with 1,496. Spain, Roumania, Great Britain, and Norway rank as above the European average, Denmark above the average with 777 head, and all the other countries below the average, the

* *Coventry Mysteries*, p. 408. † *Journal of Society of Arts.*

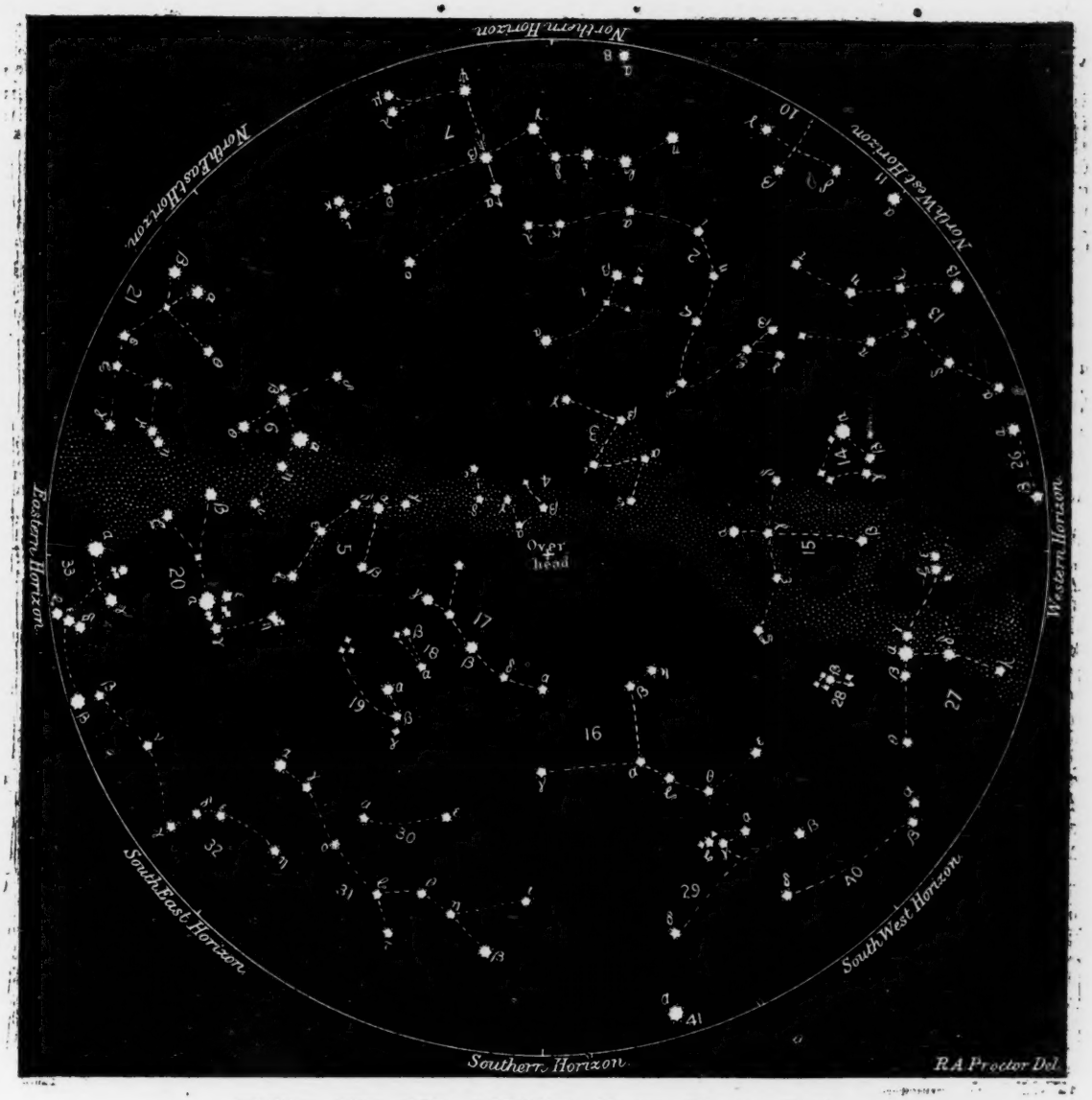
lowest in rank being Holland, Switzerland, and Belgium, with 121 head. Of swine, Servia has relatively also the largest number, namely, 1,062 head, whilst Spain, which follows next, has only 272, then Denmark with 263; Portugal, Austria, Roumania, and Germany being all above the average, France about the average, and the remaining countries below, the lowest in rank being Sweden, Holland, Italy, and Norway, with only 56 head. In an examination of the total numbers of live stock in the different countries, it will be found that Russia has the decided superiority, taking all classes of animals together. This country, including Poland and Finland, in the year 1876, possessed 25,000,000 head of horned cattle, 45,000,000 sheep, 10,000,000 swine, and 17,000,000 horses. The increase during the last twenty years has been greatest in sheep—about 20 per cent.; whereas the increase of horned cattle and swine has only been about 4 per cent.; and horses have remained stationary. Next to Russia, Germany has the largest number of horned cattle—about 15,000,000, of sheep 25,000,000, of swine 7,000,000, and of horses 3,000,000. In Prussia there has been, of late years, a considerable increase in all classes of animals; in Saxony and Baden it has been stationary; while in Bavaria, Wurtemberg, Hesse, and Oldenburg there has been a falling off. Austria, with Hungary, ranks third on the list, so far as horned cattle and swine are concerned, respectively with 12,000,000 and 7,000,000; in the second rank as regards horses, namely, 3,000,000, but only in the sixth rank as regards sheep, with 20,000,000. After Austria, France has the next largest number of horned cattle, about 11,000,000 head, while it only occupies the fourth place for sheep and swine, namely, 24,000,000 and 5,000,000, and 2,000,000 horses. From 1850 to 1872 there was a considerable falling off in horned cattle in France, but in later years there has been a steady improvement. Great Britain follows next in regard to horned cattle, namely, with 9,000,000 head; but, in respect to sheep, stands second on the list with 32,000,000; she takes the fourth rank in respect to horses, viz., with 2,750,000, but for swine only the sixth rank, with 4,000,000. Live stock in Great Britain has fallen off very considerably of late years; for example, from 1874 to 1880 there was a decrease of 500,000 head of cattle, 4,000,000 sheep, and 750,000 swine. Italy ranks last with respect to horned cattle, with 3,500,000 head, 1,000,000 horses, 9,000,000 sheep, and 3,750,000 swine. Of late years there has been a falling-off in the number of horned cattle, but sheep show an increase. In Holland the absolute number of live stock may be given as 1,500,000 head of cattle, 1,000,000 sheep, 500,000 swine, and 300,000 horses. The cattle interest in this country is of considerably more importance than the culture of cereals, about 40 per cent. of the land area being devoted to meadow and grass land. Denmark, in the cattle census of 1881, was stated to possess about 347,500 horses, 1,470,000 head of horned cattle, 1,548,600 sheep and lambs, and 527,000 swine. These figures, as compared with the previous census of 1876, show a very considerable increase in horned cattle and swine, while there is a diminution in the number of horses to the extent of 5,000, and in sheep of 170,000. In Norway, where the cattle interest is of more importance than cereal culture, the number of horned cattle is given at about 1,000,000 head, sheep at about 1,700,000, but of swine not more than about 100,000. Lastly, Sweden appears with 2,000,000 head of horned cattle, 1,500,000 sheep, 500,000 horses, and 450,000 swine. Taking the extra European countries, the United States comes first with its enormous and steadily-increasing amount of live stock, which, notwithstanding the large annual increase of population from natural causes as well as from the great tide of emigration annually pouring into the country, has been fully able to keep pace with its relative position to the population. According to the latest returns, the number of horned cattle in 1882 amounted to 41,000,000; of sheep and lambs, 49,000,000; horses, 11,000,000; and swine, 43,000,000. From Canada there are no later census returns than those of 1871, when the numbers given were 2,700,000 head of horned cattle, about 3,000,000 sheep, and 1,500,000 swine. South America has relatively a larger number of animals even than the United States, especially the La Plata States are noted for their enormous hordes. Statistics place the number of horned cattle at 19,500,000 head, with 70,000,000 sheep, and about 500,000 swine. In the Pampas the horned cattle are estimated at 30,000,000. In Algeria the number of live stock in 1879 was stated as 1,200,000 head of horned cattle, and about 9,000,000 sheep. As regards Australia, the stock of animals in these colonies has received a very great increase during the last ten years. In the census of 1878, horned cattle are stated as 7,400,000, as compared with 4,700,000 in 1876; sheep, 61,000,000, against 51,000,000; and swine, 815,000, against 695,000. The proportion of live stock to every 1,000 inhabitants is very large, being as much as 2,800 head for horned cattle, 23,400 for sheep, and 310 for swine.

## FIRST STAR LESSONS.

By Richard A. Proctor.

THE constellations included in the twenty-four maps of this series are numbered throughout as follows (the names being omitted on the maps, to clear these as far as possible from all that might render the star-grouping less distinct):—

1. *Ursa Minor*, the *Little Bear* (*a*, the *Pole Star*).
2. *Draco*, the *Dragon* (*a*, *Thuban*)
3. *Cepheus*, *King Cepheus*.
4. *Cassiopeia*, the *Lady in the Chair*.
5. *Perseus*, the *Champion* (*β*, *Algol*, famous variable).
6. *Auriga*, the *Charioteer* (*a*, *Capella*)
7. *Ursa Major*, the *Greater Bear* (*a*, *β*, the *Pointers*).
8. *Canes Venatici*, the *Hunting Dogs* (*a*, *Cor Caroli*).
9. *Coma Berenices*, *Queen Berenice's Hair*.
10. *Boötes*, the *Herdsman* (*a*, *Arcturus*).
11. *Corona Borealis*, the *Northern Crown*.
12. *Serpens*, the *Serpent*.
13. *Hercules*, the *Kneeler*.
14. *Lyra*, the *Lyre* (*a*, *Vega*).
15. *Cygnus*, the *Swan* (*a*, *Arided*; *β*, *Albires*).
16. *Pegasus*, the *Winged Horse*.
17. *Andromeda*, the *Chained Lady*.
18. *Triangula*, the *Triangles*.
19. *Aries*, the *Ram*.
20. *Taurus*, the *Bull* (*a*, *Aldeburan*; *η*, *Alcyone*, chief *Pleiad*).
21. *Gemini*, the *Twins* (*a*, *Castor*; *β*, *Pollux*).
22. *Cancer*, the *Crab* (the cluster is the *Beehive*).
23. *Leo*, the *Lion* (*a*, *Regulus*).
24. *Virgo*, the *Virgin* (*a*, *Spica*).
25. *Libra*, the *Scales*.
26. *Ophiuchus*, the *Serpent Holder*.
27. *Aquila*, the *Eagle* (*a*, *Altair*).
28. *Delphinus*, the *Dolphin*.
29. *Aquarius*, the *Water Carrier*.
30. *Pisces*, the *Fishes*.
31. *Cetus*, the *Sea Monster* (*o*, *Mira*, remarkable variable).
32. *Eridanus*, the *River*.
33. *Orion*, the *Giant Hunter* (*a*, *Betelgeux*; *β*, *Rigel*).
34. *Canis Minor*, the *Lesser Dog* (*a*, *Procyon*).
35. *Hydra*, the *Sea Serpent* (*a*, *Alphard*).
36. *Crater*, the *Cup* (*a*, *Alkes*).
37. *Corvus*, the *Crow*.
38. *Scorpio*, the *Scorpion* (*a*, *Antares*).
39. *Sagittarius*, the *Archer*.
40. *Capricornus*, the *Sea Goat*.
41. *Piscis Australis*, the *Southern Fish* (*a*, *Fomalhaut*).
42. *Lepus*, the *Hare*.
43. *Columba*, the *Dove*.
44. *Canis Major*, the *Greater Dog* (*a*, *Sirius*).
45. *Argo*, the *Ship*.




NIGHT SKY FOR OCTOBER (SECOND MAP OF PAIR),

Showing the heavens as they appear at the following hours:—

| | | |
|---|---|---|
| At 10 o'clock.....October 22. | At 9¼ o'clock.....November 3. | At 8½ o'clock.....November 14. |
| At 9¾ o'clock.....October 26. | At 9 o'clock.....November 7. | At 8¼ o'clock.....November 18. |
| At 9½ o'clock.....October 30. | At 8¾ o'clock.....November 10. | At 8 o'clock.....November 22. |

## EARTHQUAKES.

BY RICHARD A. PROCTOR.

IT is related in the *Timæus* of Plato that the ancient Egyptians held the world to be liable to occasional widely-extended catastrophes, by which the gods checked the evil propensities of men, and cleansed the earth from guilt. Conflagrations, deluges and earthquakes were the instruments of the wrath of the offended gods. After each catastrophe mankind were innocent and happy, but from this state af virtue they gradually fell away, until their accumulated offences called for new judgments. Then the gods took counsel together, and unable to bear with the multiplied iniquities of the human race, swept them from the earth in some great cataclysm, or sent a devouring flame to consume them, or shook the solid earth until hills and mountains fell upon and crushed the inhabitants of the whole world.

One can understand how the confused records of great catastrophes, in which all, or nearly all, the inhabitants of wide districts were destroyed, led in the course of time to the formation of such views as Plato has described. And, indeed, it is not in one nation alone that

we find theories of this sort prevalent. In the *Institute of Menu* the Hindoos are taught that at the end of each of those cycles of ages which are termed the "days of Brahma," all forms of life are destroyed from the earth by a great conflagration, followed by a deluge which inundates heaven itself. The mythical legends of the Chinese refer to similar views, which appear also in the Babylonian and Persian cosmogonies. The Chaldeans taught that when the planets are all conjoined in Capricorn the earth will be overwhelmed by a flood, and that when a conjunction of this sort takes place in Cancer the earth will be destroyed by fire.

In the present age when the network of telegraphy brings all parts of the earth into close intercommunication, we are not likely to trace, even in the most widespread disasters, the approaching destruction of our globe. The same day which brings the intelligence of some desolating catastrophe brings evidence also that the devastation is but local. We are seldom informed of simultaneous, or nearly simultaneous, events happening in widely-separated regions of the earth's surface. Accordingly, we are seldom led to dread the occurrence of any widely-devastating series of catastrophes.

We have heard a great deal lately of certain speculations—recently ventilated by an American philosopher—which threaten the earth with complete annihilation. According to these views there is one great danger to which we are at all times liable—the risk, namely, that some large volcanic vent should be formed beneath the bosom of ocean. Through this vent the sea would rush into the interior of the earth, and being forthwith converted into steam by the intense subterranean heat, would rend the massive shell on which we live into a thousand fragments.

Whether it is possible or not that such an event as this should take place, I shall not here stay to inquire. Let it suffice that the risk—if there be any—is no greater now than it has been any time during thousands of past years.

But certainly, if there is any source from which the inhabitants of the earth may reasonably dread the occurrences of widely devastating catastrophes, it is from earthquakes. It is related that for full six months after the great earthquake of Lisbon, Dr. Johnson refused to believe in the occurrence of so terrible a catastrophe. "He spoke half jestingly," Macaulay thought—it is not easy to see on what grounds. To us it seems far more probable that Johnson heard with natural wonder and awe of the destructive effects of this fearful convulsion; and that for awhile he could scarcely believe that the extent of the disaster had not been exaggerated. It would be well if, indeed, the powers of earthquakes were less tremendous than they have been repeatedly shown to be. "There is," says Humboldt, "no other outward manifestation of force known to us—the murderous inventions of our own race included—through which, in the brief period of a few seconds or minutes, a larger number of human beings have been destroyed than by earthquakes." Lightning and storm, war and plague, are but weak and inefficient agents of destruction in comparison with the earth's internal forces.

And as earthquakes surpass all other phenomena as agents of sudden destruction, so the impression which they produce on those who for the first time experience their effects is peculiarly and indescribably awful. Men of reputed courage speak of a feeling of "intolerable dread" produced by the shocks of an earthquake, "even when unaccompanied by subterannean noises." The impression is not that of simple fear but a feeling of absolute pain. The reason seems for awhile to have lost the power of separating real from imaginary causes of terror. The lower animals, also, are thrown into a state of terror and distress. "Swine and dogs," says Humboldt, "are particularly affected by the phenomenon of earthquakes." And he adds that "the very crocodiles of the Orinoco, otherwise as dumb as our little lizards, leave the shaken bed of the stream and run bellowing into the woods."

Humboldt's explanation of the peculiar sensations of alarm and awe produced by an earthquake upon those who for the first time experience the effects of the phenomenon is in all probability the correct one. "The impression here is not," he says, "the consequence of the recollection of destructive catastrophes presented to our imagination by narratives of historical events; what seizes us so wonderfully is the disabuse of that innate faith in the fixity of the solid and sure-set foundations of the earth. From early childhood we are habituated to the contrast between the mobile element water and the immobility of the soil on which we stand. All the evidences of our senses have confirmed this belief. But when suddenly the ground begins to rock beneath us, the feeling of an unknown mysterious power in nature coming into operation and shaking the solid globe arises in the mind. The illusion of the whole of our earlier life is annihilated in an instant."

Use habituates the mind to the shocks of earthquake. Humboldt found himself able after awhile to give a close and philosophic scrutiny to the circumstances attending the phenomenon which had at first impressed him so startlingly. And he tells us that the inhabitants of Peru think scarcely more of a moderate shock of earthquake than is thought of a hail-storm in the temperate zone.

Yet the annals of earthquakes are sufficient to give rise to a feeling of dread, founded, not merely on the novelty of the event, but on a knowledge of the powers of the earth's internal heavings. The narratives of some of the great earthquakes afford fearful evidence on this point.

In the first shock of the great earthquake of Lisbon (November, 1755) the city was shaken to its foundations. The houses were swung to and fro so violently that the upper stories fell at once, causing a terrible loss of life. Thousands rushed to the great square in front of St. Paul's Church, to escape the reach of the tottering ruins. It was the festival of All Saints, and all the churches had been crowded with worshippers. But when the terrified inhabitants reached the square, they found that the great church of St. Paul's was already in ruins, and the immense multitude which had thronged its sacred precincts were involved in its destruction. Such of the congregations of the different churches as had escaped rushed to the banks of the Tagus for safety. There were to be seen priests in their sacerdotal vestments, and an immense crowd of people of all ranks and ages, praying to Heaven for mercy. As they prayed there came the second shock, scarcely less terrible than the first. The church on the top of St. Catherine's Hill was rocked to and fro till it fell, crushing in its fall a great multitude which had sought that height for safety.

But a far more terrible catastrophe was at hand. As the banks of the river sounded with the *Miserere* of the terrified supplicants who had crowded thither for safety, there was seen to pass over the wide expanse of the stream (here four miles broad) a strange heaving swell, though no wind stirred the air. The waters seemed to be drawn away to meet a vast wave which was now first

observed to be bearing down upon the devoted crowd. They strove to fly, but the wave swept too rapidly onwards. The whole multitude was overwhelmed in a moment. A magnificent quay, lately built at a great expense, was engulfed with all who had crowded on it for refuge. Numberless vessels, also, which were anchored on the river and were now full of terrified people—seeking on an unstable element the security which the solid earth denied them—were sucked down by the tremendous wave, and not a trace of them was ever afterwards seen.

A third shock followed, and again the river was swept by a gigantic wave. So violently was the river moved that vessels which had been riding at anchor in deep water were flung upon the dry ground. Other shocks and other inroads of the river-water followed, each working fresh destruction, insomuch that many began to believe that "the city of Lisbon was doomed to be entirely swept from the face of the earth."

It would be out of place to describe here at length how fire and pestilence came successively to complete the desolation begun by the earthquake's ravages. The terrible story has been narrated elsewhere. But what remains to be mentioned gives us startling evidence of the terrible energy of the earth's subterranean forces:—

The mountains Arrabida, Estrella, Julio, Marvan, and Cintra, some of the largest in Portugal, were shaken from their very foundations, they opened at their summits, and huge masses were flung into the neighbouring valleys. Flames and smoke were emitted from the openings. But much farther away the effects of the great convulsions were experienced. It has been computed, says Humboldt, that a portion of the earth's surface four times greater than the whole extent of Europe was simultaneously shaken. On the coasts of Sweden and on the shores of the Baltic, far away across the Atlantic to the Antigua Islands, at Barbadoes and Martinique, and still further off in the great Canadian Lakes, the movement was sensibly felt. A vast wave of inky blackness swept over the West Indian seas, rising twenty feet above the level of the highest tides. In Algeria the earth was as violently shaken as in Portugal, and eight leagues from Morocco a village with 8,000 inhabitants was swallowed up.

The shocks felt at sea were so violent that captains who experienced them thought their ships had struck the solid ground. A ship 120 miles to the west of St. Vincent was so violently shaken that the men were thrown half a yard perpendicularly upwards from the deck. Lakes and rivers in England were strangely agitated. The water in Loch Lomond suddenly rose against the banks without apparent cause, and then as suddenly subsided—the vibration of the earth's surface having travelled from Lisbon to Scotland at the rate of twenty miles a minute!

It has been calculated that in Lisbon alone 60,000 persons perished within the brief space of six minutes. But there have been other earthquakes in which even this terrible destruction of life has been surpassed. In 1693, 100,000 persons fell victims to the great Sicilian earthquake, and upwards of 300,000 persons are supposed to have perished in the great earthquakes which desolated Antioch in the sixth and seventh centuries. It has been estimated that within the last 4,000 years five or six millions of human beings have perished through the effects of earthquakes.

It is related that in the great earthquake of 1747 all the inhabitants of the town of Callao were destroyed, save one. The man who escaped, standing on a fort which overlooked the harbour, saw the sea retire to a distance and then return like a vast mountain in height. "He heard a cry of *Miserere* rise from all parts of the city," and in a moment all was silent—where the town had once flourished there was a wide sea. But the same wave which overwhelmed the town drove past him a small boat, into which he flung himself, and so was saved.*

## THE COLUMBIA TYPE-WRITER.

By John Browning.

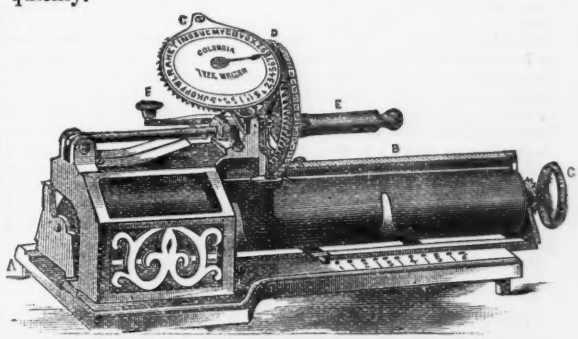
TYPE-WRITERS have just recently been making rapid strides, and they are now within a measurable distance of general adoption.

About thirty years ago I planned and began making a type-writer, and I do not suppose I was by any means the first person the idea occurred to. My attention was distracted from this idea by the charms of the spectroscope, and I have never returned to the subject since. But I have watched the production of the various type-writers with very lively interest, and used one occasionally for several years.

When I first adopted a type-writer I dispensed with the services of a shorthand clerk; but I soon found that no type-writer could arrange books and papers for me, and I therefore engaged one again. Yet I would never write any amount of matter with a pen in future if I could get a thoroughly-satisfactory type-writer. The Remington was brought out some years since, and it has been extensively adopted, and had it not been for the high price, about £20, it would doubtless have been still more generally used.

Since the Remington we have had the Caligraph machine, constructed on the same plan, containing some improvements.

Still more recently we have had several type-writers of a smaller size, and more economical in price. The Hall machine is portable and efficient, and the price is only £8. 8s. I have no experience of this machine, but I should think that it would be difficult to write with it quickly.




The Anglo-American type-writer I have not been able to see, though I have tried to get a sight of it, so that although it has been advertised extensively, I am not sure whether it is really in the market.

The latest type-writer introduced, and I should think, take it all round, the best, is the Columbia. In this machine the type is on the rim of a small wheel. When

* It must be remarked, however, that Sir Charles Lyell estimates the number of the saved at 200, "of whom twenty-two were saved on a small fragment of the fort of Vera Cruz, which remained as the only memorial of the town after this dreadful inundation."

the type-wheel is turned by means of a straight handle, held between the fingers, a hand points to the letter which is in the position for printing on a dial; simply depressing the handle then prints the letter on the paper, and raising the handle again moves the paper-carrier forward, and inks the type for the next operation. The act of depressing the handle locks the type-wheel, so that it cannot turn while the letter is being printed.

Excellent letterpress copies, two in number, may be made from the writing done with the Columbia; but six perfect copies may be obtained at one operation on the machine itself by using thin paper and carbon paper alternately.

The Columbia Type-writer weighs less than six pounds, and the price, with one wheel of type, in case complete, is only £5. 5s.; with two wheels of type, to print both capitals and small letters, the price is £6. 6s.

I have printed a few pages with the machine, and I find it very easy to use. When I have had some amount of practice with it, I will report further respecting the speed which may be attained, as this is an all-important consideration.

## THE FACE OF THE SKY.

FROM OCT. 9 TO OCT. 23.

BY F.R.A.S.

SPOTS and faculæ continue to be visible at intervals on the Sun's face. Map X. of "The Stars in their Seasons" shows the aspect of the night sky. Minima of Algol will occur at 1h. 26m. a.m. on Oct. 20, and again at 10h. 15m. p.m. on Oct. 22. Mercury comes into superior conjunction with the sun at 10h. a.m. on Oct. 16, and will be, for all practical purposes, invisible during the next fortnight. Venus is an evening star, but is very badly placed for the observer on account of her considerable and rapidly-increasing south declination. If seen at all it will be over the south-west horizon just after sunset. Mars, Jupiter, and Uranus are all equally invisible for the purpose of the ordinary amateur observer. Saturn is visible during the late working hours of the night. He rises about 9h. 11m. this evening, and about a quarter past 8, when our notes terminate. Hence he is fairly high up by midnight. He continues to form a triangle with ε and ζ Geminorum. Neptune remains in the old blank region in Taurus. The Moon enters her first quarter at 1h. 20·7m. a.m. on Oct. 16, and is full on Oct. 23, at 9h. 22·6m. at night. No occultations of fixed stars occur during the period covered by our notes. When they begin the Moon is in Virgo, but at 7 o'clock this evening she will pass into Libra. She is travelling through Libra until 4h. 30m. p.m. on the 11th, when she arrives at the narrow northern strip of Scorpio. Passing through this, at 2h. 30m. in the early morning of the 12th she enters Ophiuchus, which she leaves in turn at midnight on the 13th for Sagittarius. She remains in Sagittarius until 2h. 30m. p.m. on the 16th, at which hour she crosses into Capricornus. She leaves Capricornus for Aquarius at 9 a.m. on the 17th; and Aquarius for Pisces at 3 p.m. on the 20th. Her passage through this huge constellation is not completed until 4 p.m. on the 23rd, when she passes into the north-west corner of Cetus. She is still there at midnight on the 23rd.

THE *Chicago Railway Age* states that over 1,650 trains pass over the junction of the New York Elevated Railroads at Chatham-square every twenty-four hours. No railroad in the world does an equal train business on two tracks. There is a junction in London where 2,400 trains pass daily, but four tracks are provided for their accommodation. The only railroads in operation that compare with the New York Elevated Railroad system for crowded business are the London Underground Railways. The Underground Railways carry an enormous number of passengers, and the traffic has developed very rapidly. In 1879 a total of 91,420,178 persons were carried by the London Underground Railways, while in 1884 the number had increased to 114,447,514. During the corresponding five years the New York Elevated Railroads showed an increase from 46,045,181 to 96,702,620; in other words, while the Underground showed an increase of 23,027,336 in five years, the Elevated had expanded its figures by 50,667 430

## Gossip.

BY RICHARD A. PROCTOR.

I HOPE, in the next number, which will be the last weekly number of KNOWLEDGE, to give a full account of the probable form in which the first monthly number of KNOWLEDGE will appear. At present I note only that it will contain, besides the letter mentioned in the next paragraph (which many will regard as its chief attraction), an article by Mr. Grant Allen, on "Nature's Way of Spreading Seeds"; the opening paper of a series by Mr. Clodd, on "The Story of Creation"; a paper by a Fellow of the Astronomical Society, on "Colour"; the beginning of a series of papers by Mr. Mattieu Williams on "Coal" (in its commercial aspect), a subject which he has in a special manner made his own; a paper on "Indian Myths," by Stella Occidens; and probably a paper by Miss Ballin, on "Thought." I have not yet heard from other regular contributors. I begin a series of papers on the "Southern Skies," illustrated by maps prepared for the latitudes of Melbourne, Sydney, Cape Town, Dunedin, and other important southern cities; in fact, suitable for Australia, New Zealand, Tasmania, Cape Colony, &c., and likely to interest northern people who wish to know more than the books teach about the celestial phenomena of the southern skies. I also begin a series of papers on the religion of science. The "Face of the Sky" would no longer have the fitness which it had in KNOWLEDGE as a weekly; but monthly astronomical announcements will be made, and, perhaps, records of each past month's celestial phenomena. Chess will continue under the able management of "Mephisto," who has recently achieved such noteworthy success; and "Mogul," the skilful Whist-player, has promised a series of papers on Whist which cannot but be of great interest.

IN the first monthly number of KNOWLEDGE there will appear a long and most interesting letter by Sir John Herschel, written in the year 1869, and hitherto unpublished. It relates to my own inquiries, then little more than begun, and presents in clear terms his ideas at that time, when—in the fulness of years but also in the fulness of his powers—he was resting after the close of his long and noble series of astronomical labours.

I PROPOSE to follow up that letter by some others in which Sir John Herschel discussed the theories which his father had enunciated. I hope hereafter to be able to publish in connected form some of the more important of the elder Herschel's papers. This is much needed.

IN nearly every work on general astronomy which has been published during the last half-century, a certain theory of the stellar universe is described and illustrated. According to this theory the system of stars forms a figure which has been compared to a cloven flat disc. Near the centre of the disc is the sun, while around the sun a small circle is drawn, which is intended to represent a sphere enclosing all stars visible to the unaided eye. The portion outside represents a section of the cloven disc of stars,—the single extension on one side corresponding to the enormous array of the stars whose united lustre produces the light of the Milky Way where that stream is single, while the double extension on the opposite side corresponds to the arrays of stars producing the two streams into which along one-half of its course the Milky Way is divided. The theory and the illustration are

both referred, quite justly, to Sir Wm. Herschel, and the reader is further informed that according to the views accepted by astronomers of our time the system of stars really has the figure assigned to it by the theory so fully and so frequently described and illustrated.

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Yet, surprising as it may seem, the theory referred to is one which Sir William Herschel himself has distinctly rejected, as not in accordance with the evidence he obtained during the progress of his researches. This "generally accepted theory" with which every reader of even the most elementary treatises on astronomy is familiar, is one which no astronomer who has read Sir William Herschel's works through can possibly accept as the true theory of the sidereal system. I know nothing which in a more marked manner illustrates the careless way in which our astronomical text-books are prepared than this,—that a theory which its own deviser rejected as unsound, has been presented over and over again as embodying nearly all that is known about the general structure of the sidereal heavens. One writer has borrowed the theory from another—neither inquiring into its real merits nor being at the pains to study the papers of the great astronomer who first propounded it; until at length it has come to pass that the few who have ventured to challenge the theory have been regarded as little less rash than the paradoxists who are always overthrowing the theory of gravitation.

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I remember well the awe-struck—almost horror-struck—looks with which many of the Fellows of that very Society which might be expected to know best what Herschel taught, regarded me when I said that a greater astronomer than the propounder of the theory had overthrown it. "Sir Wm. Herschel put forward this theory of the stars," I remarked, "but it was attacked and overthrown more than a quarter of a century later by an astronomer of greater experience, by an observer far more skilful, by a theoriser at once more daring and more cautious. This man, the greatest observational astronomer that has ever lived, and excepting Newton himself, the astronomer who has most profoundly affected the views of men respecting the celestial depths, has pronounced that the theory of the star-system which appears in almost all the astronomical text-books of our day is not a sound one, because not based on trustworthy hypotheses. The astronomer who thus proved that Sir Wm. Herschel had been wrong was Sir Wm. Herschel himself. The appeal is from Sir Wm. Herschel in 1785, the most skilful and laborious observer of his day, to Sir Wm. Herschel a quarter of a century later, compared with whom, the Herschel of 1785, great as he was, was yet but a beginner." Many, if not most of those to whom I addressed these remarks, considered (I know well) that either I was mistaken or else that I was drawing somewhat largely on my imagination.

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I was not aware when I thus addressed the Royal Astronomical Society that the German astronomer Wm. Struve had expressed precisely the same opinion. Here are the words in which, after summing up the labours of Sir Wm. Herschel during the years immediately following the enunciation of the theory of 1785, Struve speaks of the result to which those labours had led:—"Nous parvenons donc au résultat peut-être inattendu mais incontestable, *que le système de Herschel, énoncé en* 1785 *sur l'arrangement de la Voie Lactée, s'écroule de toutes parts, d'après les recherches ultérieures de l'auteur; et que Herschel lui-même l'a entièrement abandonné.*

It is strange that the country in which the elder Herschel received his scientific training should know so little of his works. We have to turn to German literature to obtain a satisfactory, though not quite complete account of Sir Wm. Herschel's researches. His own masterly papers are written indeed in our language, but those who would read them must search through no less than thirty-seven of the thirty-nine volumes of the "Philosophical Transactions," published between the years 1780 and 1818. England has not done what Wilhelm Struve urged her to do. She has not yet honoured herself by "honouring the memory of her greatest astronomer," so far as to publish "at least a complete and systematic edition of his works."* Nor again has the position which the work of the younger Herschel bears with respect to the labours of the father been adequately presented in any English treatise on astronomy, the subject being one which would naturally not receive at his own hands—in his fine "Outlines of Astronomy"—either exhaustive or sufficiently appreciative treatment.

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A correspondent sends us the following amusing letter from the *Derby Daily Telegraph*, together with an article about the Derby ghosts from the same paper,—asking if we can wonder there are ghosts at Derby:—

Sir,—A correspondent in your Tuesday night's issue presents us with a sample of Mr. Proctor's statements, some of which are taught in our schools to the rising generation. Just imagine the editor of Knowledge being lauded and applauded for such burning imaginative utterances as the following:—That the earth, sun, and moon are planets, requiring millions of years' process to advance to the stage he states the moon to be in, "decrepid." Will the reader just compare this with the Mosaic account found in Genesis, that not quite six thousand years ago God created on the fourth day two great lights, sun and moon, to rule day and night, also for signs and for seasons. Thus the moon cannot be the sun's senior by twelve hours. Yet we are expected to believe it millions of years. I respect my Bible too much for that, and have learned to value its statements as true. Mr. Proctor also pretends to describe the roarings of a cyclone in the sun, also to give its velocity as 100 miles per second. Readers, think of these statements, and ask how these things can be determined on a body ninety-five millions of miles distant, a distance which no human eye can reach with the most powerful aid. If the sun was double its size and of ten thousand times the brilliancy they say it is, one million miles would place it out of our limit of minute investigation.—I remain, yours truly, E. T. Taylor.

Although of course such letters reflect discredit where they appear, I fancy Derby is well on a level with the best towns in England for general intelligence and education. My audiences there, both when I lectured recently, and when I lectured for the Gilchrist Fund, were among the best I have addressed.

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The reduced telegraph tariff is one of the most successful hits the Post-office has ever made. Their estimate of an increase of thirty per cent. in the number of messages transmitted has been as nearly as possible realised. On the First the increase was nearer forty per cent., but that is accounted for by the immense number of messages sent for the sake of spending sixpence over the inauguration of the new scheme, which, so far, has worked as well as could be expected. The increase, as was anticipated, is considerably greater on the local traffic than on the provincial or "town to town" work, being for London as much as fifty per cent. It is noticeable that the increase in the actual number of messages is scarcely, if at all, felt in the instrument-rooms, the average length having been considerably reduced, and the addresses brought down to the lowest limit.

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* Struve, in his "Études d'Astronomie Stellaire." In this work the labours of the Herschels are dealt with in the true scientific spirit—not with unquestioning acceptance, though with fullest appreciation of their value enhanced by the independent analysis to which the German astronomer has subjected them, while at the same time their intrinsic merit is made abundantly evident to the reader.

"Let knowledge grow from more to more."—Alfred Tennyson.

*Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.*

*All Editorial communications should be addressed to the* Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to, delays arise for which the Editor is not responsible.

*The Editor is not responsible for the opinions of correspondents.*

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No communications are answered by post, even though stamped and directed envelope be enclosed.

## THUNDERBOLTS.

[1949]—I have frequently been struck by the fact of thunderbolts falling during violent storms, and of their simultaneous appearance with flashes of lightning.

That masses of matter occasionally accompany the electric fluid when it reaches the earth there is no question; they have been seen and described as "balls of fire," and I have in my possession one that fell some time ago at Casterton, in Westmoreland.

It was seen to fall during a violent thunderstorm, and, killing a sheep *en route*, buried itself about six feet below the surface, and when dug out shortly after it was still hot. In appearance it much resembles a volcanic bomb; it is about the size of a large cocoa-nut, weighs over 12 lbs., and seems to be composed of a hard ferruginous quartzite. I have not yet submitted it to a technical analysis, but hope to do so shortly. There is an external shell of about an inch in thickness, and this contains a nucleus of the same shape and material as the shell, but is quite independent of it, so that the one is easily separated from the other; I attribute this separation of the parts to an unequal cooling of the mass.

I have often wondered from whence thunderbolts were derived, and why they always fall as "balls of fire" accompanied by flashes of lightning.

It occurs to me that if ten millions of meteorites enter our atmosphere daily (*vide* Knowledge, Feb. 8, 1884), and become dissipated into vapour on coming into contact with our air, that some of these bodies might chance to survive the ordeal of passing through the more rarified zones and reach the earth, if only an airless passage could be obtained during the latter part of their journey.

By recent observations made on luminous meteors the height of the atmosphere is calculated to extend to about 200 miles. The pressure of the air at the sea-level being about 15 lb. per square inch (subject to variation), the density at a distance of 200 miles must be almost nil; in point of fact, at about 3 miles from the surface the pressure of air is reduced to 7½ lb., while at a little over 6 miles it is only 3¾ lb. per square inch, for "as the elevation increases in arithmetical progression, the density and pressure decrease in geometrical progression."

Clouds in Great Britain reach an elevation of somewhere about 6,500 ft. (being considerably higher in tropical regions). I refer to cirrus clouds. Whether nimbus or storm-clouds have reached this height in Great Britain I cannot say, but that thunderclouds are usually at a considerable height is proved by the *large* drops of rain that fall during a storm; for the greater the distance the drops have to fall the greater is the amount of moisture they take to themselves on their passage throught a moist atmosphere.

Electric storms have been observed at a height of 16,000 feet; I presume that this was not in Great Britain, but, of course, the height of any particular storm-cloud may be ascertained by calculating the time the sound of the thunder takes to reach us (at a rate of 1,130 feet per second) from the moment the lightning flash is seen.

Let it be granted then that the densest portion of our atmosphere lies between any particular thunder-cloud and the earth, and that this presents the most formidable barrier with which meteorites have to contend when approaching us. Let it also be granted that many (specially favoured) meteorites reach the regions of the highest thunder-clouds from space before being completely vapourised by friction. Then it is only required to find some medium which will absorb the air through the final (and most trying) part of their journey, and so enable them to travel onwards to the earth in vacuo.

A fiendly discharge of electric fluid from the cloud at the right moment would do this, and a meteorite following in the wake of the flash that had thus prepared a way for it, would reach the earth as a "ball of fire," bringing destruction to everything that retarded its progress. C. Carus-Wilson, F.G.S., &c.

[Does the fall of a meteorite follow the electric disturbance, or does the electric disturbance follow the fall of the meteorite? —R. P.]

## PARADISE FISH.

[1950]—Referring to the interesting account of the Paradise fish, which you quote from the *Scientific American* in your issue of Sept. 11, I notice that Mr. Holder alludes to the difficulty of transporting the fish of tropical waters to these latitudes. This I can corroborate from bitter personal experiences. Not only fish, but creatures so comparatively lowly organised as corals and molluscs, die on board ship of something analogous to sea-sickness, unless the tanks containing them are "gimbal-swung." But it seems to me that this undoubtedly great obstacle to the importation is not, after all, so nearly insuperable as to give occasion for marvel at the fact of two specimens of *Macropodus viridiflavus* reaching the States alive. Last week I saw a tubful of the closely-allied *Macropodus venustissimus*, in capital condition exposed for sale at the General Import Company's store, 177A, Euston-road, with the curious so-called "stalk-eyed" or telescope gold-fish, and other singular denizens of Eastern rivers. I once availed myself of a huge well-hung tank, originally constructed for the transmission of a manatee from Guiana (the apparatus and freight had cost something like £400, while the cow died the day after shipment), to endeavour to bring over some living flying-fish. They were put on board in splendid order at Barbados; the time of year was favourable, and the steamer one of the swiftest on the West Indian route; and I had prepared an arrangement whereby the temperature of the water in the tank (changed daily) could be raised when necessary. In fact, I spared no pains to ensure their safety, for I was offered my pick of the serpents at nearly every zoological collection in Europe in exchange for them—a very tempting bait to me. Yet they all died before we sighted the Azores. They were isolated from all rolling or pitching motion, but I suspect the vibration of the engines reached them. Arthur Stradling, C.M.Z.S.

Watford.

## MUSIC—BREATHING—STAMMERING.

[1951]—I can appreciate "Kolokol's" desire, in middle age, to use his leisure for instrumental music. I am doing it myself in another branch. I sing. With the wish to please, not torture, my unlucky hearers, I am trying to prepare myself thoroughly.

The very first step I took opened out new worlds to me, in other directions, by teaching me *how to breathe*. I never knew before. I now find very few people who do know. Almost every one I meet on a tricycle or bicycle has his mouth open, thereby indicating a difficulty of breathing. An exceptional rider shut his mouth while looking at me in passing, but opened it again as soon as he got by. Although an athlete of some experience and success, I had always handicapped myself, and even endangered my health, by false breathing with the upper part of the chest. In many sports and handicrafts the muscles of the upper part of the chest are on a strain, and fix the chest walls so much as to render breathing by means of them both difficult and unnatural. One cannot easily expand the lungs against the opposition of so many muscles and the weight of the shoulders. The effort required to do it prematurely exhausts one, and evidently was never intended to be made.

On the other hand, when the diaphragm is used to expand and contract the lower part of the chest, the operation of breathing becomes perfectly easy. One's attention and energy are left free for the work in hand. One soon feels that the diaphragm was made to work the bellows, and one notices a welcome change in the aëration of the blood and the working of the heart.

I took up tricycling some eighteen months ago, and thought it rather an exhausting pleasure. But for the last six months I have been working at singing, and from that time have really believed there might be some truth in the enthusiastic cycling screeds one reads. I found that with diaphragmatic breathing I could do any amount of work without feeling nervous or exhausted. I can suit my breathing to my work with the greatest ease. In fact, I have been surprised to observe that I never think of my breathing even up the steepest hills I ride. I note a similar improvement in walking.

Now, in the same way, stammering may be benefited. Of course, that term includes many ailments and eccentricities of speech, some of them depending on individual organisation which God has not given us the power to mend. But the art of breathing has now

fully taken its place as a practical and a useful art. If one learns to breathe properly even long-continued speech is made easy. Proper breathing may cure loss of voice, clergyman's sore throat, and many forms of stammering.

"Kolokol" has only to refer to Mr. E. Behnke, 12, Avonmore-road, West Kensington, to get the information he desires. He has taught me breathing, and I know he is a master of the subject. See, too, his book on "Voice, Song, and Speech," written with Lennox Browne. As Mr. Behnke knows nothing of this letter, I cannot say whether he or any one else would speculate in the manner proposed. I should think such a course would no more assure a cure than it would if taken by a fever patient with his physician. There is a limit to human art.

As to instrumental music, I fear there is no help in the direction "Kolokol" points out. Practice is the only panacea, and one's parents should encourage it in early youth. Science cannot provide new muscles; and even the success of Dr. Forbes's operation on the muscular bands between the little and fourth fingers, to free them for piano playing, is still quite undecided.

But I can assure "Kolokol" that, if he learns to breathe properly, he will notice a wonderful change in himself, and very likely stammering will disappear while learning. One caution may be added—viz., inexperienced persons should not carry the practice of deep or diaphragmatic breathing to excess. AN OLD STUDENT.

## THE BIRTH OF WORLDS.

[1952]—If the formation and the decay of planetary systems be by the processes of progression and of retrogression, of evolution and of devolution, then one important consideration has been neglected by those who have speculated on the nebula, and on the sudden appearance of stars, and that is that light, as light, has no external existence whatever. Light is not of the stars, but is the effect of mechanical vibrations, propagated by their action, impinging on the sentient eye. It is therefore probable that there may be centres of systems, now in process of development, that have not yet the power of communicating to the circumambient ether sufficient vibratory activity to produce the sensation of light in human eyes, and not until they shall possess that power will their existence be revealed unto men. This consideration, too, would account for a dawning advent to a fuller day in the revelation of a star to human eyes; may it not also help to solve the mystery of the star in Andromeda? W. CAVE THOMAS.

[These stars, however, always "go in" again. How about that?—R. P.]

## MERCURY BY DAY AND THE RED GLOW.

[1953]—On the 5th of this month the planet Mercury at transit by day became visible with my instrument for the first time for more than two years, and has been daily visible since. The copper halo round the sun, which has existed for the same period, and which has during the last six weeks diminished so as to be hardly observable, became considerably brighter again during a week of absolutely cloudless weather from the 13th inst. The fore-glow and after-glow have returned with increased splendour (accompanied almost each day by the pink arch in the opposite horizon), beginning on the 2nd to the 5th, and again from the 13th to the 23rd, that of the 22nd being finer than any yet seen here, continuing for one and a half hours after sunset, the glow extending along the northern horizon for some distance. Both the fore-glow and after-glow of the 22nd, as also the after-glow of the 2nd, 5th, and 23rd, were accompanied by bright rays of red running up half-way to the zenith.

I may add that the new star in Andromeda has been distinctly visible to the naked eye here, until the increasing moonlight prevented its being seen. M. F. W.

Partenkirchen, Bavaria, Sept. 28.

## LETTERS RECEIVED AND SHORT ANSWERS.

HALLYARDS. I thought you had no show of a case in your correction of Miss Edwards's chronology; agreed with Mr. Allen; and with Miss Ballin; differed altogether from you about past fauna; never held that life has ceased on Mars, but the contrary (as probable). Brown Sequard and I both referred to measurement for new hats—as well as to the fit of the last worn. Yet I valued your letters for lively way of suggesting new thoughts, even though mostly wrong or inexact. I never said your letters were all bosh—or said that of any of them. I cannot remember what sarcasms you wish me to forgive. Suppose it recalled to my memory and forgiven: it is certainly forgotten. I really think I can honestly say that sarcasms roll off me as water from the duck's back. As for unfairness—what letter of defence have I suppressed, *except one beginning with the remark that you would not read the letter you meant to answer?* But you have sent in more matter since the approaching end of weekly KNOWLEDGE was announced than there was room for, if all other letters had been excluded. You know little about "the gift of editing" if you suppose it includes putting gallons into half-pint measures.—About the condor question the authority you quote is simply valueless, because actual measurement has long since disproved what an "authority" who had never even seen a condor, supposed.—The master-mind who put "abutere" for "abuti" and "patientiam" for "patientiâ" was certainly not mine, nor the mind of any "Cambridge graduate." So far as I am concerned you will find the very passage, with *verbatim* translation in a not very aged number of KNOWLEDGE. If it pleases you to assert or insinuate that I believe in a Latin verb, *uto*, infinitive *utere*, to use; and that I am ignorant that "ab" in composition is followed by an ablative, I am sure I have no objection. Those are not the only mistakes you have made. But now if you supposed me really sensitive, you should have suggested the alternative that I must have written my replies very badly, and so perhaps sent the "reader" to look up—more or less hurriedly and so imperfectly—the original passage, or to recall it imperfectly from memory, or perhaps to correct it from his inner consciousness. You would have been nearer the truth that way. Yet, sensitive though I seem to be, according to your judgment, I could have borne even that terrible sarcasm, knowing that I wrote in pencil, in a joggling train. Albeit I can write pretty badly when the spirit moves me, without being joggled at all. Will this do? Yet I would wager a brass farthing, if I had one, you will *take* the last word which you ask for so piteously.—There are so many things I do not know that I see no "gibe" in telling you that you are quite mistaken about meteors not moving under attraction. Let them move as fast as they may their paths must be curved. As to the *Saturday Review*, the opinion I expressed here is universal among well-informed persons. One may say of the class of writers they employ something akin to what was once said of a paradoxist,—He is only a chemist among astronomers, only an astronomer among chemists, and both only among those who are neither. —FACIEBAT. No; the second "patientiam" was not a printer's error; the first was. In the second case I was *quoting the error*. The other mistake was A Buty, too. Then "quosque" for "quo usque." But there are excuses. And sometimes the very care and anxiety taken to make out the meaning of my bad writing causes error,—as in this case, I expect. (I am writing *this* in a train nearing Exeter, and have been writing replies and posting—at Basingstoke, Salisbury, Yeovil—besides sending off letters, writing "Gossip," and what-not, ever since I left Waterloo; I shall see no proof of this; and what the printers cannot make out —small blame to them!—they will puzzle out as best they may). *That*, if I may be permitted a colloquialism, is the special form of inconvenience experienced by "Hannah." Know nothing about the misprint *gentum* for *gentem*, page 265, *note*,—not having seen any proof of the article in question, or read it in KNOWLEDGE itself. —F. C. 1. Do not know Hitchcock's "Religion of Geology;" from the little I have heard of it I should say it was scarcely a trustworthy book. 2. Mitchell's "Orbs of Heaven" is fairly trustworthy. His explanation of dynamical matters quite unsound. Of course, in some respects the work is out of date.—F H. V. I am sorry the criticism annoyed you. As I read it, it seemed to express no opinion one way or the other between you and phonographers; while the critic admitted that (as you point out) what he said about your signs applied to all stenographic systems. I have not seen your book; nor have I seen one book in ten or in fifty, of those reviewed in KNOWLEDGE during the last eighteen months. Thanks heartily for your kindness at Christchurch. What a pleasant time that was to me!—J. SILCOCK. The present volume will end Oct. 16.—J. P. BROCHELL. I really do not know.—ONE WHO, &c. You somewhat amuse me in your apparent unconsciousness of your degraded position. "One who" writes anonymous letters *ought*, according to an old proverb, to have a better memory than you seem to have. For you certainly wrote "to that defect." As for the person you name, it so chances that he has done precisely that thing, and I knew it. Therefore I did him no injustice. I think I could put my Index Finger on *you*, if it were worth my while. I have not KNOWLEDGE for August 7th by me, so cannot find out why I am to be sorry for the remarks about Vegetarianism, which I doubt not were perfectly just—since you say they were unjust. Considering our food supply *per se*, and without fighting over tastes, we find it insufficient enough for our wants, without cutting down its best part. For, the history of ages shows that man cannot rise to his best without animal food, any more than a greyhound can do his full work if low fed. The individual can live on vegetable food, because of the stored-up energy given him by his ancestors. But it is a bad look-out for his children. You are quite right, we do not warn off anonymous writers. I am speaking of those really anonymous, and also of those who make personal attacks under that supposed cover; neither does a host warn off pickpockets by placard from the dining-room where he entertains his friends.—MISS A. Regret that we have no opening in that direction.—J. T. I do not know if lions and tigers have ever been fed for any length of time on vegetable food. I should not care to meet an animal of this kind, in a casual way, after he had

lived a month or two on a strictly vegetable diet.—N. E. B. Should not care to answer your question about conduction of heat without experimental tests. Other questions answered elsewhere. Thanks for list of errata.—H. O. C. I meant non-reappearance (nice word). It was not I who said all the matter of a comet might be put into a cocked hat. I do not know the capacity of a cocked hat, or believe comets to be so utterly insignificant anyway. From experiments made by Prof. Wright, of Yale, it appears probable that finely-divided cosmical dust *in vacuo* would be rendered incandescent, and in part vapourised.—W. Aston. I believe no such works exist. But for reference I may mention the edition of the "Encyc. Brit." preceding the present.—W. C. T. You deem me more altruistic than I am. Knowledge has changed in form chiefly because I could not longer stand the burden. My time and work since Knowledge started were simply *given away*. Computing at the average value of my time to myself, I find the gift was a large one. I could afford to make it no longer.—Omega. I am away from books of reference, and am unable to give you the title of any book of logarithms giving what you require.—A Correspondent (whose initials have unfortunately been torn off MS.) asks whether Dr. Ball's or Mr. Lockyer's astronomy is the more trustworthy. I have seen no edition of the latter work except the first, which was full of blunders (used for the supply of awful examples at Cambridge), and the American edition, which has been carefully corrected. Anything Dr. Ball writes may be regarded as thoroughly trustworthy. Or course he makes mistakes as we all do; but not from insufficient knowledge or power.—C. Carus Wilson. I should attribute the red sunsets to meteor dust. As regards thunderbolts, &c., I imagine that though electrical phenomena may often accompany the downfall of a large meteorite, no mass could possibly fall like a meteorite *because* of electrical disturbance.—J. L. Polack. You ask why do we deal with the 2/9 of 4/11 before the 3/5+2/9, when considering the expression 3/5+2/9 of 4/11. If you were told you were to receive 3/5 of a certain sum, and also 2/9 of 4/11 of the sum, would you begin to determine your share by adding 3/5 to 2/9? What earthly meaning would such a process have? You would first find what 3/5 of the sum amounted to, then what 2/9 of 4/11 of the sum amounted to, and then you would add the amounts together.—G. E. In about four hours I could give you about as much advice as you require. It would probably be all wrong, as I have no means of knowing your aptitude for the study on which you propose to enter. On the whole, it will be better to suppose your letter received a few weeks later, when no earthly power will persuade me to answer a question in Knowledge. — N. E. B. Thanks for the curious example of mental inequality. Possibly Guillemin's "Heavens," translated by Mrs. Lockyer, edited by Mr. Lockyer, and corrected by myself, might suit you. You are quite right about books of an untrustworthy sort being read as if by authorities. Glad to have made that ruddy eclipse matter clear. There was a curious example there of mental inequality, for that writer cannot even now see what is clear to many who have not half his acquaintance with some scientific matters. But such slips are unfortunate. As you for instance, in botany, your special subject, see blunders at once and want to know whether books on other subjects are as untrustworthy, so may many feel in studying papers on other subjects in which a writer is supposed to be proficient, after seeing that such a writer may have been very positive and even dogmatic when altogether in error. For that reason I regard the correction and ready admission of error as the sacred duty of a teacher of science. It is also, like honesty, good policy; but that is a mere accident of the position.—J. Russell, C., Qy.² Qy³. That quotation was marred altogether not a little: by that printer's devil, or (which is the same thing) that devil of a printer: not identified, so this is not personal. Would like well to lecture at Kingsbridge; but do not know how it may be managed.—Jas. Meredith, K. T. M., Constant Subscriber, J. M. Allen, Albert Howell, L. Means, Wearied One, Thos. Syninton, and others. Glad to find the proposed curtailment of correspondence meets your views.—G. Hailey. Apply to publishers.—J. Borrodaile. Oh why do you send us such nonsense? Abuse science to your's heart's content; but post your packet of nonsense in a pump, or a stove, or in any chance opening in a quarry. You will get just as much relief, and no one else will be troubled.—Commentator. That must have been the acting editor, for I never read such a paper.—Jas. Fraser, Jun.—One is an alteration of direction, the other of distance. Deflect a telescope through a very small angle, and it will bear on a widely different point on the horizon; but shift it ten feet, keeping its direction unchanged, and no appreciable effect will be produced.—X. Ah! You think any nonsense, even the rubbish written by Parallax, a Lady Mathematician, John Hampden, and other foolish persons, might be written by any one who is an admirer of Herbert Spencer. Interesting information truly! Possibly you do not know what nonsense those three *have* written. The middle one in particular was a twaddler "of the first water," having little claim to either half of her assumed name.

# Our Inventors' Column.

*We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions* (Knowledge *being a popular magazine*) *than is accorded by the most excellent trade journals.*

## THE COMBINATION EASEL DESK.

This desk, introduced by David Clarke & Co., Small Heath, Birmingham, is the result of careful study of the requirements of an art-student. It is very light, simple, and compact, there being no complicated machinery of any kind about it. It is rendered equally applicable for drawing, painting, clay-modelling, or writing by the raising and adjustment of the desk top.

The top of the desk is hung with hinges upon the front side, and is adjusted to any desired slope by means of a toothed rack. On the front edge of the desk top is a movable ledge, consisting of a bar of metal in which are slots of an L shape, through which pins are made to pass, and by which it is fixed to the top. This ledge forms a rest for the drawing-board, canvas, or cast, whilst, when not required for that purpose, it can, by means of the vertical and longitudinal slots be depressed below the level of the desk-top, leaving the top free from projection for writing purposes. A movable and adjustable light metal frame, for holding copies, objects, casts, &c., is fixed to the back part of the desk-top, and is so constructed that it may be adjusted to any inclination to the desk-top, or, for convenience, be lowered down behind it out of the way. This is effected by means of a slot, pin, axle, and quadrant rack, so that by lifting the whole rail the length of the slot the student is enabled to place the copy or cast in the best position for work. One advantage of this frame is that the object to be copied, whether drawing or cast, is not foreshortened, but can always be kept at right angles to the student's eye. On the left-hand side of the desk is provided a space for the reception of drawing-boards when not in use, and also a receptacle for pencils, instruments, &c. There is also a water-pot for colouring purposes, carried in a fixed or swinging bracket, and fixed to one of the legs, or on the side rail of the desk, according to choice, and a hole is left in the desk-top at the back and on the right-hand side for the reception of this pot, so that it may be used when the desk-top is not inclined. The desk is said to be fast gaining popularity in the Midlands, for its simplicity and practical adaptability to the requirements of an art student.

## PORTABLE CAMERA STAND.

Mr. Ashford has patented a portable camera stand, in which each leg is composed of three pieces; one forming, when extended, the bottom half of the leg slides between the other two pieces. On the inner sides of the pieces which form the upper half of leg grooves are cut dovetail in shape, and on each side of the sliding piece are corresponding pieces to fit in these grooves. Two brass clips fasten together the lower end of the upper half of stand, and a brass screw with milled nut passes through the upper end to fasten the leg to the head. Across the upper end of sliding piece are cut two grooves, one on each side, about an inch wide; into these grooves are fitted two cheeks which extend across the sliding piece on to the two pieces which form the upper half of leg. Right through these (the sliding piece and cheeks) is passed a brass screw with milled head, and at the back is fastened the nut. By merely loosening this screw the sliding part may be moved freely up and down, and can again be fastened in any required position. The head is made triangular in shape, and has three hollow projecting ears, the width of which corresponds with the sliding part of leg. Across these ears grooves are cut to fit the screws in top part of leg. Underneath the head and across these grooves are placed springs, so that when the metal pins in top end of legs are pushed along these grooves they are held safely by the springs until released. The advantages claimed for this stand are its firmness, portability, the facility with which it is set up and taken down, simplicity of manipulation, and the fact that having a long slide, it can be used on the side of a hill or on any uneven ground as easily as on the flat.

# Our Whist Column.

By "Five of Clubs."*

## HOME WHIST.

THERE is no reason why Whist should not be far more in vogue as a home game than those mere chance games at cards which seem regarded as the only games suited to the intelligence of a family party. My own experience has shown me that much better Whist can be played in the home circle than an average club table will supply; while Home Whist is free from the annoyances and rudenesses too often observable in Club Whist. Unfortunately, Whist played at home is usually, for want of a little instruction in Whist principles, so very bad, that few care to sit down to it. My chief object in this little treatise is to show how Home Whist may be made at once interesting and profitable: interesting because of the wonderful variety and beauty of the game itself; profitable because, while it is an amusing recreation, it is one which has the great advantage of taxing skill and exciting pleasant and wholesome emulation.

At the outset, I must make a few remarks on the laws of the game, on the best plan for obtaining that due observance of the laws without which Whist loses half its interest, and on the method of playing which is best suited for home play.

Club players, who are usually most unequal in skill as well as in that care which should almost wholly obviate occasion for referring to the code, are very strict in exacting penalties for mistakes, whether of omission or of commission. The long list of laws which they require to know (*ninety-one!*) would be quite out of place in Home Whist, as also would be the squabbles which these multitudinous laws appear to engender. (My own belief is that the stakes played for in clubs, whether guinea points or only shilling or sixpenny points are in question, are the real cause of most of the disputes and of much of the bad temper too often shown in club play.)

Yet there can be no doubt that, to be really enjoyable, Whist should be played strictly. Home players should try to show, by strict attention to the rules, that money stakes are not essential, as most Whist players contend, to the enjoyment of sound Whist.

Therefore, without adopting the complicated, ill-worded, and in some respects imperfect code used in clubs,† let us consider a few rules, in accordance with the accepted code, but suited for home play.

In family play, it is best to arrange the players according to some system agreed on beforehand, instead of cutting for partners. Thus, either a systematic rotation of arrangements may be adopted, each player having each of the rest for partner in succession, or else, where there are always the same four, the same pair may for a long spell of time be matched against the other two.

In cutting for deal the lowest card wins the deal; and *for this purpose* the cards range in value thus: Ace, lowest; then two, three, &c., to Knave, Queen, and King, highest.

It is best to use two packs. Dealer's partner makes and shuffles the cards, and places them on his (own) right, ready for the next dealer. The dealer may shuffle the cards afresh if he likes, before placing the pack beside the player on his right to be cut.

Any mistake in dealing which cannot be corrected without counting the cards or altering the position of more than one card is a misdeal. It is better perhaps, even in home play, to let a misdeal lose the deal. Yet if all are agreed that they care more for the play than for mere trick-making, there is no real occasion to waste time in a fresh deal, where the hands can be easily rectified. But where the dealing has been so careless that one or more cards have been exposed, it is not right to condone the fault, for the play cannot but be affected by knowledge of the position of any cards besides the trump. Let the deal in that case pass to the next hand, as it would in club play. When this has happened once or twice the careless dealer will show marked improvement.

The trump card should remain exposed until it is the dealer's turn to play to the first round. It is a good habit for the dealer to systematically place the trump card in his hand before playing to the first trick. After this, the other players may not ask what is the trump *card*, but only what is the trump *suit*.

In playing, it is well to be neither hasty nor too deliberate. Hurried play, besides leading to faults of strategy, results often in offence against the laws. Leading out of turn should be regarded as an offence for which the full penalty must be exacted, even in home play; *because it often gives an otherwise unfair advantage.* That in reality is the only point to be considered in applying the laws to home play,—viz., to secure fair and equitable strategy. If my partner takes a trick with the Ace and I hold the King of the suit, I may show him by leading that King, when it is not my turn, the way to a great game: in this case it is not sufficient to call on my partner to lead instead; it is only right and proper to call upon him to lead some other suit, if the adversaries wish. So in all such cases the rigour of the law may be properly applied; for nothing tends more to impair the harmony of Home Whist than the loss of tricks, be they few or many, through an inadvertence of one of the adversaries. Instead of saying in such a case *afterwards:* "It was not right to show that card, for it put your partner in the way to make a trick or tricks which otherwise we should have saved," the proper thing, in home play, is to say *at once*, but pleasantly: "That card tells your partner too much" (showing how it does so): "we are sorry, but, that your mistake may not cause us loss, we must call for a suit, even at the risk that we may gain a trick or so through your mistake."

If a player throws his cards on the table supposing the game won or lost, those cards, according to Club Whist, may be called; and I have seen cases where a sure game has been lost through this bad habit, and others where a game not really lost has been made a lost game by the enemy calling the cards in destructive order. In Home Whist, or wherever the play is not for money, all that should be required, where a player throws down his cards claiming a won game, is that he should show how the game may be surely won against any *play*, even though it could not be won if the enemy named in particular order the cards he was to lead. And in like manner if a player throws down his cards under the impression that the game is lost, his partner, if he sees a way by which the game might have been saved, should be entitled, in *Home Whist*, to save the game if he can against the best play by the enemy,—only this must be done independently of knowledge gained by the exposure of the cards. Of course, this is heresy to many club players, who regard the saving or winning of a game by calling the cards in such cases as among the choicest treats Whist affords. But Home Whist should be a more generous game. It is a good rule, though, never to expose the cards, except in absolutely certain cases.

*(To be continued.)*

* From the forthcoming little work on "Home Whist," by Richard A. Proctor.

† It is given in full in my treatise "How to Play Whist," and is worth reading if only as a curiosity for its bad English.

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Stoopid.—(Since you *wish* to be so called.) Can you give any reason for playing Heart Ace (in second line of play), when Heart Six will take the trick? I cannot.

---

An Eclipse of the Sun.—To convey anything like an adequate idea of the effect of an eclipse on different minds, the writer can hardly do better than describe the eclipse he witnessed in Egypt in 1882. On the banks of the Nile, about one mile north of the town of Sohag, a large concourse of spectators was assembled to witness the forthcoming spectacle. A small party of these spectators were gathered around a number of instruments, doubly protected from the injurious sand-winds by stockades of rushes and by tents. A space extending about 300 yards, and enclosed on each side by the Nile and the outskirts of a grove of acacia trees, scarcely 200 yards away, was guarded by a body of Egyptian soldiers. Protection was only wanted from incursions of the curious; but had the natives been less informed of what was to take place, Egyptian soldiery, only a little less cowardly than the felaheen, would have been small protection against any fanatical outbreak. The river was lined with steamers, dahabeahs, and smaller craft, whilst to the south of the encampment, on the sloping bank, were gathered a large concourse of the inhabitants of the neighbouring villages, squatting on the sand in their peculiar Eastern fashion. The eclipse began and made some progress before the unscientific spectators noticed that the sun was fast disappearing; but when they became aware of it they gave vent to their feelings by a low moaning, the sound increasing in volume as the moon passed on. The alarm now spread to the feathered spectators, who, becoming at last cognisant of the rapidly waning light, rushed cackling hither and thither, into steamboat or into observatory, in search of a place in which to roost. At last a thin streak only of light was left; it disappeared, and there was a sudden change from weak daylight to a dull violet, which threw on the neighbouring scenery a weird, ghastly hue. At this moment a sudden shout arose from the crowd—a shout unheeded, scarcely heard, by the astronomers, who suppressed their excitement, and endeavoured to make the most of the seventy seconds during which totality was to last. And yet even they were taken off their guard, for alongside the brilliant corona was seen a small, but vivid, scimitar-shaped comet—a stranger unexpected, and never afterwards traced. Little wonder, then, if the regulation forbidding speech was for a moment disregarded. The short seventy seconds were soon over, the last observation made, and whilst one set of spectators were raising their thanks to Allah, the other had laid aside their calm reserve to join in mutual congratulations.—C. Ray Wood, in *Cassell's Family Magazine.*

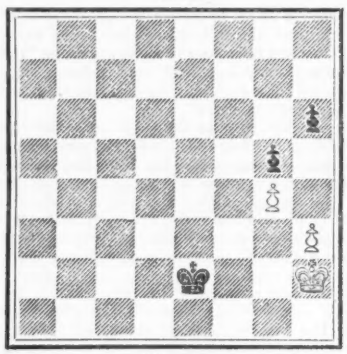
# Our Chess Column.

By Mephisto.

## DIFFICULT POSITIONS.

THE following neat End Game study, according to an American contemporary, originated in a match game played at New York:—

Black.



White.

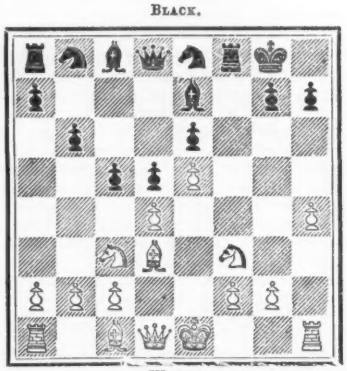
Black to move and win.

This is a position which may easily occur. White threatens P to R4 and K to R3. If Black plays K to B6. P to R4, K × P (best). P × P, P × P. K to Kt2 the game would be drawn, as White has the opposition. But Black can win in the following curious manner:—

| | |
|---|---|
| | K to B7 |
| P to R4 | P to R4! |
| K to R3 | K to B6 |

and whatever White does, Black will be enabled to gain a move by checking, and Queen first, and win.

Black.



White.

THE above position occurred in a game played last week. From the nature of the position our readers will readily recognise this to be a game at the odds of Pawn and move. White has driven the Kt back to K sq. by P to K5, and has taken advantage of Black Castling prematurely, in order to direct his attack against the weak K side. Black seeks to engage White's attention on the Q side, where he threatens to displace the B from his advantageous position by P to B5, or to play P × P followed on Kt retaking by B to B4. The game proceeded with:—

| | |
|---|---|
| 10. Kt to KKt5 | B × Kt |

This is forced. If Black plays P to Kt3, White can reply 11. Kt × RP, and if K × Kt White mates in four moves, beginning with 12. Q to R5 (ch). Then again, if Black plays 10. P to KR3, White would continue with 11. Q to R5.

| | |
|---|---|
| 11. B × B | Q to B2 |

This move serves the object of attack, Black thereby threatening the KP after P × QP. True, White can attack the Q by Kt to Kt5, but then the Q plays to Q2, threatening P to B5.

12. Q to R5

An ill-judged move. White intended forcing Black to advance his KKtP, so that after retiring his Q, he should be able to attack the P by P to R5. The strategy is good in itself, but did not take account of Black's obvious intention against White's centre, in other words, the counter attack.

| | |
|---|---|
| | P to Kt3 |
| 13. Q to Kt4 | P × P |
| 14. Q × P | Kt to QB3 |

and Black won. Black's play shows that his success was due to an effort at a counter attack, which he combined with his defending moves. White, on the other hand, lost the game by not pressing his attack with sufficient vigour in a position in which he could easily have obtained a won game. Thus, either on his 10th or 11th move, Black, by sacrificing his B, could have forced a win. Similar positions occur often, but it seems not often enough to be known even to strong players. It is very seldom indeed that Black has means of meeting the attack resulting in similar positions from B × RP, Kt to Kt5, and Q to R5. In this game, White ought to have continued as follows:—

| | |
|---|---|
| 10. B × P (ch) | K × B |

Of course neither K to R sq. nor K to B2 would do any good, on account of 11. Kt to Kt5 (ch), &c.

| | |
|---|---|
| 11. Kt to Kt5 (ch) | B × Kt |

If K to Kt sq., then 12. Q to R5 could force Black to take the Kt. Neither is K to Kt3 feasible, on account of 12. P to R5 (ch).

| | |
|---|---|
| 12. P × B (ch) | K to Kt sq. |

13. Q to R5

Threatening 14. P to Kt6 and mate on R8. This leaves Black absolutely no resource but

R to B4

So far White mentally analysed the position on his 10th move, and seeing no immediate win he abandoned 10. B × P or 11. B × P in favour of his adopted continuation. But he could soon obtain a winning advantage by

| | |
|---|---|
| 14. P to KKt4 | R to B6 |
| 15. P to Kt6 | K to B sq. |

16. B to Kt5 and wins.


# Mr. R. A. Proctor's Lecture Tour.

*Subjects:*

| | |
|---|---|
| 1. LIFE OF WORLDS | 5. COMETS AND METEORS |
| 2. THE SUN | 6. THE STAR DEPTHS |
| 3. THE MOON | 7. VOLCANOES. |
| 4. THE UNIVERSE. | 8. THE GREAT PYRAMID. |

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Nov. 2, Chester; Nov. 3, 5, 7, Southport; Nov. 4, Burnley; Nov. 9, Stafford; Nov. 10, Streatham; Nov. 11, 13, Sunderland; Nov. 12, Middlesbrough; Nov. 17, Darwen; Nov. 19, Saltaire; Nov. 23, Bow and Bromley Institute; Nov. 24, Trowbridge; Nov. 25, 28, Bath; Nov. 26, 30, Clifton.

Dec. 2, 5, Bath; Dec. 4, Clifton; Dec. 7, 8, 9, Croydon; Dec. 11, Chester; Dec. 14, Dorchester; Dec. 15, Weymouth; Dec. 16, 17, 18, 19, Leamington.

Jan. 4, 6, 8, Barrow-in-Furness; Jan. 12, Hull; Jan. 15, Stockton; Jan. 26, Bradford; Jan. 27, Busby (Glasgow); Jan. 28, 29, 30, Edinburgh.

Feb. 1, 2, Edinburgh; Feb. 3, Alexandria; Feb. 4, Rothesay; Feb. 5, Chester; Feb. 6, 20, Malvern; Feb. 9, 12, 19, Cheltenham; Feb. 10, Walsall; Feb. 11, Wolverhampton; Feb. 15, Upper Clapton; Feb. 18, 25, London Institution; Feb. 22, Sutton Coldfield.

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